Activities of Japanese Steel Industry to Combat Global Warming

Report of "JISF's Commitment to a Low Carbon Society"

February 2021

The Japan Iron and Steel Federation

Index

JISF's Commitment to a Low Carbon Society - Phase I

Japanese steel industry is supporting the Commitment to a Low Carbon Society by fighting global warming with the "three ecos" created during the Voluntary Action Plan along with COURSE50.

2020←2013

Eco Process

The target is a CO_2 emission reduction of 5 million tons by FY2020 vs. expected emissions for each production volume (BAU) by fully implementing state-of-the-art technologies. Of this reduction, JISF prioritizes 3 million tons of reduction arising from energy conservation and other voluntary actions by steelmakers. For waste plastics and other recycled materials, the emission reduction includes only a decrease resulting from the increase in the volume of these materials collected vs. the FY2005 level.

Eco Solution

Contribute worldwide by transferring the world's most advanced energy-saving technologies to other countries (especially to developing countries)and increasing the use of these technologies. (Estimated emission reduction contribution of about 70 million tons in FY2020)

Eco Product

By supplying the high-performance steel that is essential to create a low-carbon society, contribute to lowering emissions when finished products using this steel are used (Estimated emission reduction contribution of about 34 million tons in FY2020)

2050←

Development of CO2 Ultimate Reduction System for Cool Earth 50 (COURSE50)

Cut CO_2 emissions from production processes about 30% by using hydrogen for iron ore reduction and collecting CO_2 from blast furnace gas. The first production unit is to begin operations by about 2030*. The goal is a widespread use of these processes by about 2050 in line with the timing of updates of existing blast furnace facilities.

* Assumes establishment of economic basis for CO_2 storage infrastructure and creation of a practical unit using these processes.

1. Eco Process

On February 20, 2014, JISF became the first industry association in the world to receive ISO50001 certification (energy management system). This certification recognizes measures to combat global warming in the Voluntary Action Plan/Commitment to a Low Carbon Society as well as activities for conserving energy.

QUALITY ASSURANCE

JIC

REGISTERED ORGANIZATION

No. N001-ISO 50001

JICQA

登録証

登録組織：一般社団法人 日本鉄鋼連盟

所 在 地：東京都中央区日本橋茅場町３－２－１０ 鉄鋼会館内

貴組織のエネルギーマネジメントシステムは、当社による審査の結果、下記の適用規格の要求事項に適合していることを証します。

適用規格：ISO 50001:2011/JIS Q 50001:2011

登録範囲：日本鉄鋼連盟の低炭素社会実行計画に参加する企業の鉄鋼製品製造に関するエネルギーを基にした、以下を主要プロセスとする日本鉄鋼連盟としてのエネルギーマネジメント
・日本鉄鋼連盟運営委員会によるエネルギー方針の策定・フォロー
・日本鉄鋼連盟エネルギー技術委員会によるエネルギーデータの解析、低炭素社会実行計画の立案及び実施フォロー
・参加企業各社のエネルギー集計担当者を通じたエネルギーデータの調査・集計及び確認

登録番号：N001

更新日：2020年 2月20日

初回登録日：2014年 2月20日

有効期限：2023年 2月19日

更新決定日：2020年 1月23日

日本検査キューエイ株式会社

東京都中央区新富二丁目15番5号

代表取締役社長 川崎 博史

JICQA

Certificate of Registration

This is to certify that
the Energy Management System of

The Japan Iron and Steel Federation

at

3-2-10, Nihonbashi-Kayaba-cho, Chuo-ku, Tokyo, 103-0025 Japan

having been assessed by JIC Quality Assurance Ltd.,
conforms to the requirements of applicable standard:

ISO 50001:2011/JIS Q 50001:2011

Scope of Certification:

JISF's energy management based on the energy use for producing steel products by the companies which participate in JISF's commitment to a low carbon society, represented by the following main processes
- Establishment and following up of the energy policy by JISF's executive board meeting
- Analysis of the energy data and planning and following up the commitment to a low carbon society by JISF's energy and technology committee
- Survey, calculation, and examination of the energy data through a person in charge of investigation of the energy data in each company which participates in JISF's commitment to a low carbon society

[JISF: The Japan Iron and Steel Federation]

Certification No.: N001

Date of recertification: February 20, 2020

Date of initial certification: February 20, 2014

Date of expiry: February 19, 2023

Date of recertification decision: January 23, 2020

JIC Quality Assurance Ltd.

2-15-5, Shintomi, Chuo-ku, Tokyo, Japan

Hirofumi Kawasaki

Hirofumi Kawasaki, President

Initial registration:	February 20, 2014
1st extension:	February 2, 2017
2nd extension	January 23, 2020

(Reference) Reexamination of Stance for Targets Established in FY2016

Eco Process Before reexamination

The target is a CO_2 emission reduction of 5 million tons by FY2020 vs. expected emissions for each production volume (BAU) by fully implementing state-of-the-art technologies.

Interim- Review

1. Properly determine BAU by reflecting changes in steel production mix
2. Include actual emission reductions resulting from the use of waste plastics and other recycled materials

Eco Process After reexamination

The target is a CO_2 emission reduction of 5 million tons by FY2020 vs. expected emissions for each production volume (BAU) by fully implementing state-of-the-art technologies. Of this reduction, JISF prioritizes 3 million tons of reduction arising from energy conservation and other voluntary actions by steelmakers. For waste plastics and other recycled materials, the emission reduction includes only a decrease resulting from the increase in the volume of these materials collected vs. the FY2005 level.

Calculation of BAU Emissions for FY 2019 Performance Evaluation

(1) Calculation of BAU Emission prior to adjustment

Calculated using the regression equation* and crude steel output

BAU regression equation: y = 1.271x + 0.511 (x=Crude steel output)

* The correlation function for crude steel output and CO_2 emissions was established based on the regression equation obtained by analyzing the correlation between crude steel output and CO_2 emission intensity for FY2005-FY2009 (using the FY2005 electricity coefficient every year).

FY2018 crude steel output (total for participating companies) = 94.87 million tons

Adjustment FY2019 BAU emissions = 171.64 million tons of CO_2 (A)

(2) Calculation of change in CO_2 emissions due to change in production mix

CO_2 conversion using changes in upstream (pig iron ratio) and downstream (product category mix) processes based on the RITE index

Upstream change volume: +3.52mn tons of CO_2

Downstream change volume: -1.51mn tons of CO_2

FY2019 change in CO_2 due to change in production mix (upstream and downstream): +2.01 mn tons of CO_2 (B)

(3) Adjusted BAU Emissions

FY2019 adjusted BAU Emissions = 173.64 million tons of CO_2 [(A) + (B)]

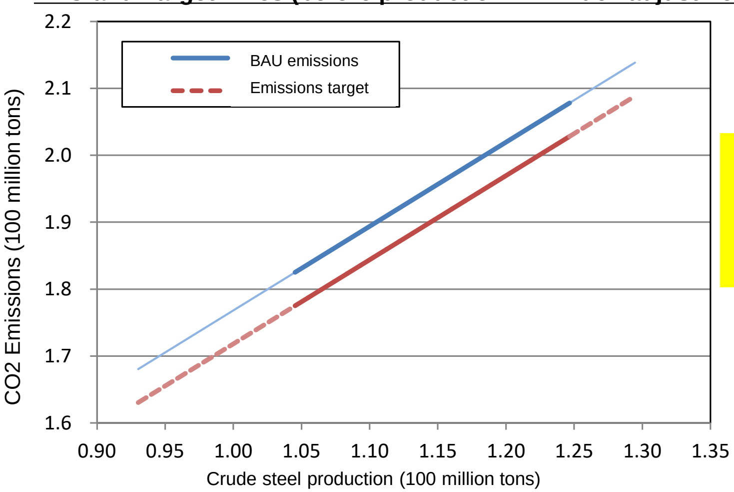
(Reference) Reexamination of BAU by reflecting changes in steel production mix

- Up to FY2014, the JISF's Commitment to a Low Carbon Society used evaluations with a BAU line (left graph) incorporating the assumption that the FY2005 production mix will not change.
- Currently, changes are taking place in the production mix. For example, as Japanese steelmakers move production to Southeast Asia and other overseas locations, the shift of some final production processes has raised the percentage of intermediate products (such as hot-rolled sheets). Also, the percentages of some finished products (such as galvanized sheets) are decreasing. Pig iron production has increased in proportion to these changes and CO_2 emissions are rising as a result.
- Incorporating these changes was not possible with the previous BAU line. Consequently, the change in CO_2 associated with the production mix change was calculated by using the production mix index produced by RITE (the RITE index). Starting in FY2015, emissions have been evaluated by using the adjusted BAU line, which incorporates the BAU line.

Until FY2014

Assumes no change in production mix from FY2005 level

BAU and Target Lines (before production mix index adjustment)



* This target assumes that Japan's crude steel output will be 120 million tons, with a variance of no more than 10 million tons.

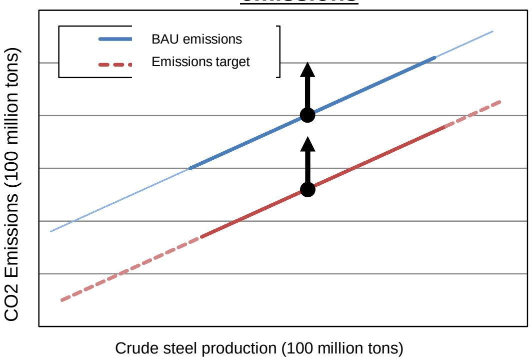
* The colored sections of the graphs on this page show the range of production at companies participating in the Commitment to a Low Carbon Society when Japan's crude steel output is between 110 million and 130 million tons.

Used for FY2019

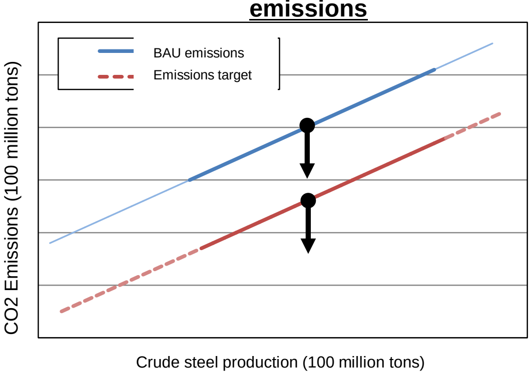
Since FY2015

Adjusted to reflect production mix change since FY2005

When production mix change increases CO_2 emissions



When production mix change reduces CO_2 emissions



(Reference) Changes in steel production mix

- When determining the RITE index, the total change in CO_2 emissions caused by a production mix change is evaluated by adding the changes in emissions associated with a change in the pig iron ratio for upstream processes and a change in the product mix for downstream processes.
- The BAU line uses a production mix that remains the same as in FY2005. As a result, it is possible to perform a proper evaluation with the BAU line in which the changes in the production mix are incorporated by shifting the line according to the changes.

Pig Iron Ratio (Upstream processes)

An increase of **2.6 percentage point in pig iron's share** from FY2005 to FY2019

	2005	2018	2019	19 vs 05 (1,000t)	19 vs 05 (%)	19 vs 18 (1,000t)	19 vs 18 (%)
Crude steel (1,000t)	112,718	102,886	98,426	▲ 14,292	▲ 12.7 %	▲ 4,460	▲ 4.3 %
BF-BOF (1,000t)	83,645	76,854	74,900	▲ 8,745	▲ 10.5 %	▲ 1,954	▲ 2.5 %
EAF (1,000t)	28,595	25,655	23,192	▲ 5,403	▲ 18.9 %	▲ 2,463	▲ 9.6 %
Pig iron (1,000t)	82,937	75,920	74,994	▲ 7,943	▲ 9.6 %	▲ 926	▲ 1.2 %
BF-BOF (%)	74.2%	74.7%	76.1%	+ 1.9 %	-	+ 1.4 %	-
EAF (%)	25.4%	24.9%	23.6%	▲ 1.8 %	-	▲ -1.4 %	-
Pig iron (%)	73.6%	73.8%	76.2%	+ 2.6 %	-	+ 2.4 %	-

CO_2 conversions using the RITE index to incorporate the above changes

Upstream:	+ 3,520 t-CO2
Downstream:	▲ 1,512 t-CO2
Total:	+ **2,008** t-CO2

Long and Flat Products Ratio (Downstream processes)

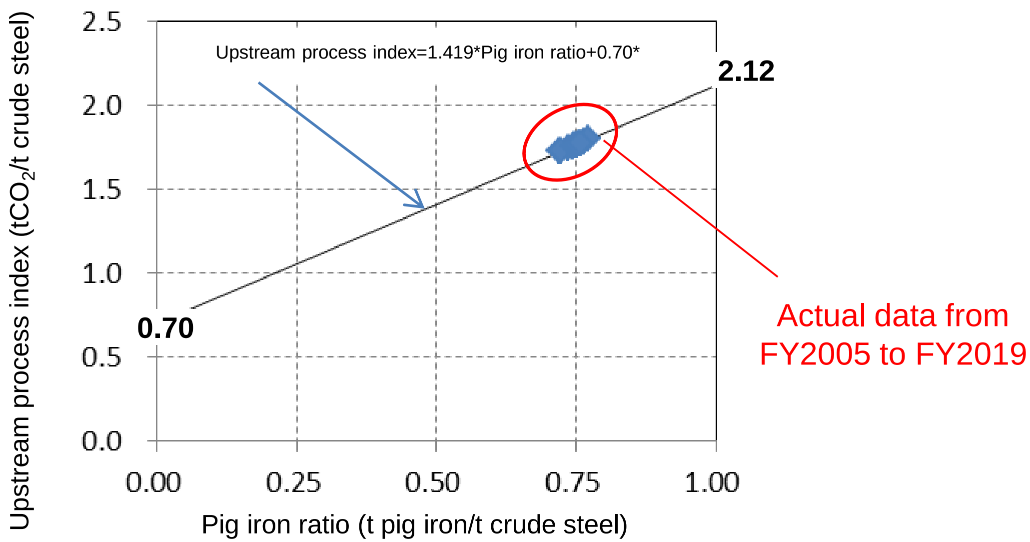
In flat products, **HRS (hot-rolled strips) increased and cold-rolled flat products and galvanized sheets decreased**

steel type		2005 ratio	2018 ratio	2019 ratio	19 vs 05	19 vs 18
Long	Shape	7.5 %	6.9 %	6.5 %	▲ 1.0 %	▲ 0.4 %
	Bar	12.3 %	10.3 %	10.0 %	▲ 2.3 %	▲ 0.3 %
	total	**23.5** %	**20.4** %	**19.7** %	▲ **3.8** %	▲ **0.7** %
Flat	Plate	11.3 %	10.9 %	10.8 %	▲ 0.5 %	▲ 0.1 %
	HRS	11.3 %	16.7 %	19.3 %	+ 8.0 %	+ 2.6 %
	Cold-rolled flat products	8.6 %	8.0 %	7.7 %	▲ 0.9 %	▲ 0.3 %
	Galvanized sheet	14.6 %	12.7 %	12.2 %	▲ 2.4 %	▲ 0.5 %
	total	**46.3** %	**48.7** %	**50.6** %	+ **4.3** %	+ **1.9** %

(Reference)Summary of the Upstream Process Index

- Crude steel is made by reducing natural resources to make pig iron or by using steel scrap that has already been reduced. The pig iron ratio is the amount of pig iron produced in relation to the production of crude steel (pig iron output divided by crude steel output). Variations in this ratio also affect unit CO_2 emissions.
- To evaluate this effect properly, a primary coefficient is established that includes (1) comprehensive energy statistics, (2) IEA energy balance table, (3) environmental reports of steelmakers, (4) international peer-reviewed papers and other items.
- The number obtained by using this primary coefficient is the upstream process index. The formula is: y (Upstream index) = 1.419 x (Pig iron ratio) +0.70.
- Changes in CO_2 emissions caused by changes in the pig iron ratio are calculated by multiplying the difference between the upstream process index for FY2005 and each subsequent year by crude steel output.

Relationship between Pig Iron Ratio and Upstream Process Index



* This equation incorporates (1) comprehensive energy statistics, (2) IEA energy balance table, (3) environmental reports of steelmakers, (4) international peer-review papers and other items.

Actual data (FY2005 and FY2019)

	Pig iron ratio	Upstream process index
FY2005	0.736	1.743
･ ･ ･	･ ･ ･	･ ･ ･
FY2019	0.762	1.780

FY2005: 1.419×0.736+0.70=1.743
FY2019: 1.419×0.762+0.70=1.780

Change in CO_2 emissions due to change in pig iron ratio (FY2018)

(1.780-1.743) ×94,87 mnt = 352 mnt

⇒Assessed as a 352 million ton increase in CO_2 emissions

(Reference) Summary of the Downstream Process Index

Unit CO_2 emissions per ton of production* have been established for different shapes of ordinary steel and types of specialty steel, a total of 35 product categories, for which general statistics are accessible. Using FY2005 as the reference year, the change in CO_2 emissions caused by the change in the production mix in each year is then calculated. This calculation is performed as follows.

Meanwhile, up until the FY 2017 report, the total amount was calculated by multiplying the above-mentioned difference between the unit emission figure for FY 2005 and the same figure for the year under review by the amount of production of crude steel. However, changes in the downstream processes are changes in the mix of steel product categories. Therefore, starting from fiscal 2018 report, the amount computed by multiplying the amount of production of crude steel by the yield ratio of steel products to crude steel for FY 2005 (this is equivalent to the amount of production of steel products) is used to calculate the total amount.

A. The product mix ratio for each steel product in each year (Table 1) and unit CO_2 emissions (Table 2) are multiplied (Table 3).

B. All the numbers obtained from the step A are added (which yields a composite unit emission value-weighted for the production mix): 0.846 in FY2005 and 0.828 in FY2019 in the table below

C. The total amount is calculated by multiplying the difference between the composite unit emission figure for the year under review and the same figure for the base year (FY 2005), which is obtained in step B, by the amount for the year under review that is computed by multiplying the amount of production of crude steel by the yield ratio of steel products to crude steel for FY 2005 (this is equivalent to the amount of production of steel products).

For FY2019: (0.828-0.846) x 94.87mnt x 0.907 = -1.51 mnt

*Unit CO_2 emissions for each steel product category for all years are based on the worldsteel LCI data collection. Averages for Japan calculated by using actual FY2014 data are used when available for these products. For products where there is no Japan average, unit emissions are estimated by using the relationship between unit emissions for steel for which Japan averages exist and selling prices (FY2010 export prices using trade statistics).

		Steel bars	Hot-rolled strips	Cold-rolled sheets	Galvanized sheets	……	Total
Product mix ratio (1)	FY2005	12.3%	9.9%	6.6%	12.0%		100%
	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	FY2019	10.0%	17.0%	6.2%	9.7%		100%
Unit CO_2 emissions per ton of production (2) (common figures)		0.73	0.67	0.71	0.96		—
(3) = (1) x (2)	FY2005	0.09	0.07	0.05	0.11		0.846
	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	FY2019	0.07	0.11	0.04	0.09		0.828

A composite unit emission figure that reflects the product mix in each year

FY2019 Results of JISF's Commitment to a Low Carbon Society

Progress toward targets

*Totals for companies participating in the Commitment to a Low Carbon Society

- Crude steel production: 94.87 million tons (down 12.2% from FY05)
- BAU emissions for FY19 crude steel production: 173.64 million tons of CO_2
- CO_2 emissions (using FY05 electricity coefficient): 170.34 million tons of CO_2 (down 9.6% from FY05)
- Reduction vs. BAU: 3.30 million tons of CO_2 (0.30 million tons over achievement)

FY2019 Energy Consumption and CO_2 Emissions

*Totals for companies participating in the Commitment to a Low Carbon Society

- Energy consumption: 2,070PJ (down 9.5% from FY05)
- CO_2 emissions (using electricity coefficient with FY18 credit): 172.61 million tons (down 8.4% from FY05)

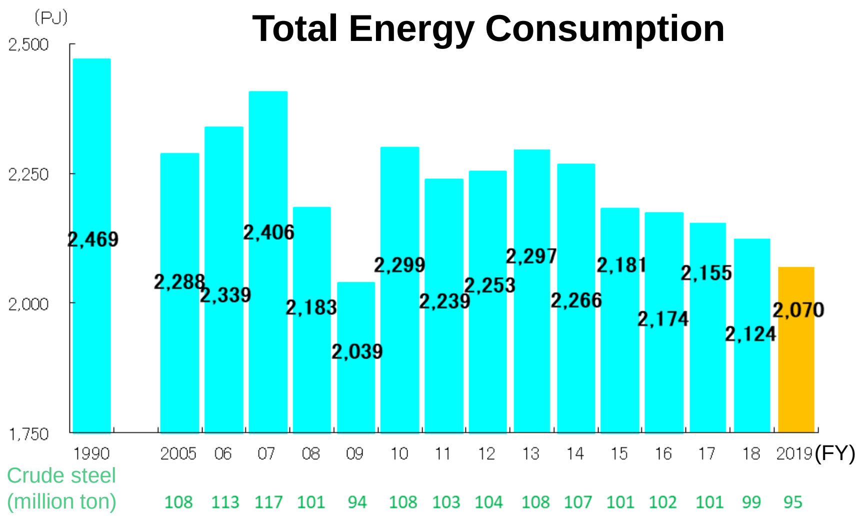
Reference: Japanese steel industry total

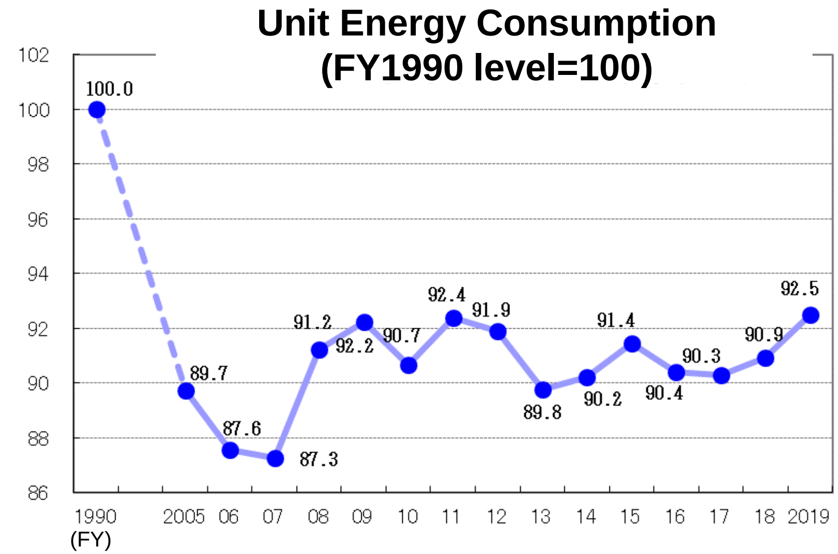
(including not participating companies participating in the Commitment to a Low Carbon Society)

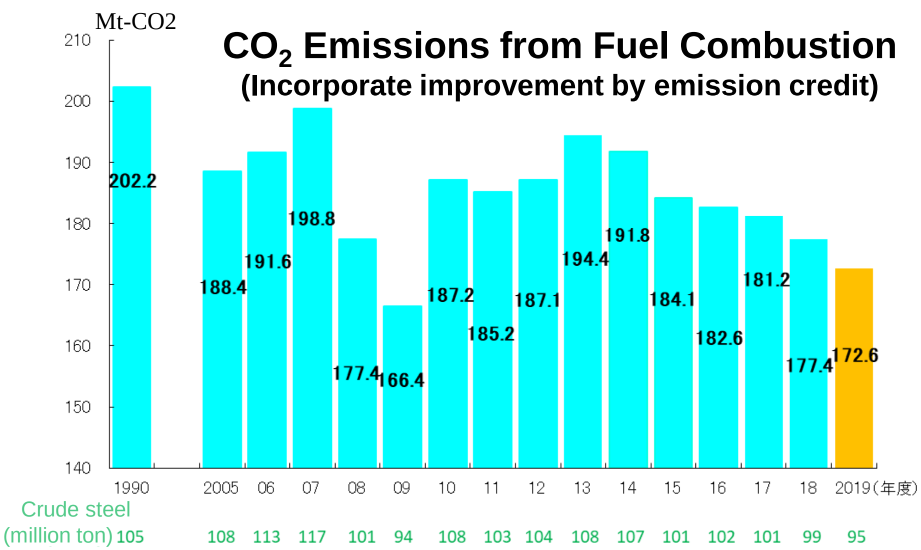
- Crude steel production: 98.43 million tons (down 12.7% from FY05)
- Energy consumption: 2,144PJ (down 9.2% from FY05)
- CO_2 emissions (using electricity coefficient with FY18 credit): 176.71 million tons (down 8.3% from FY05)

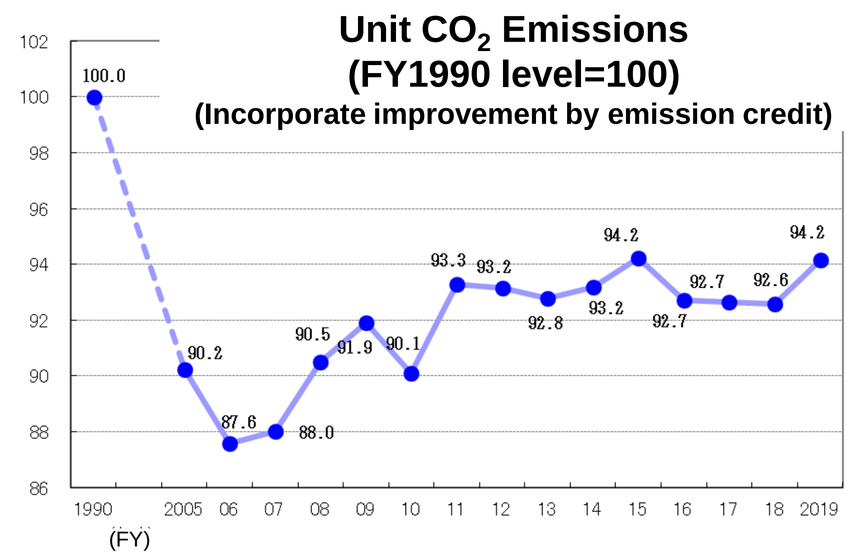
* Energy consumption and CO_2 emissions for the Japanese steel industry are estimates based on statistics for the use of petroleum and other energy sources.

Annual Trend of Energy Consumption and CO_2 Emissions







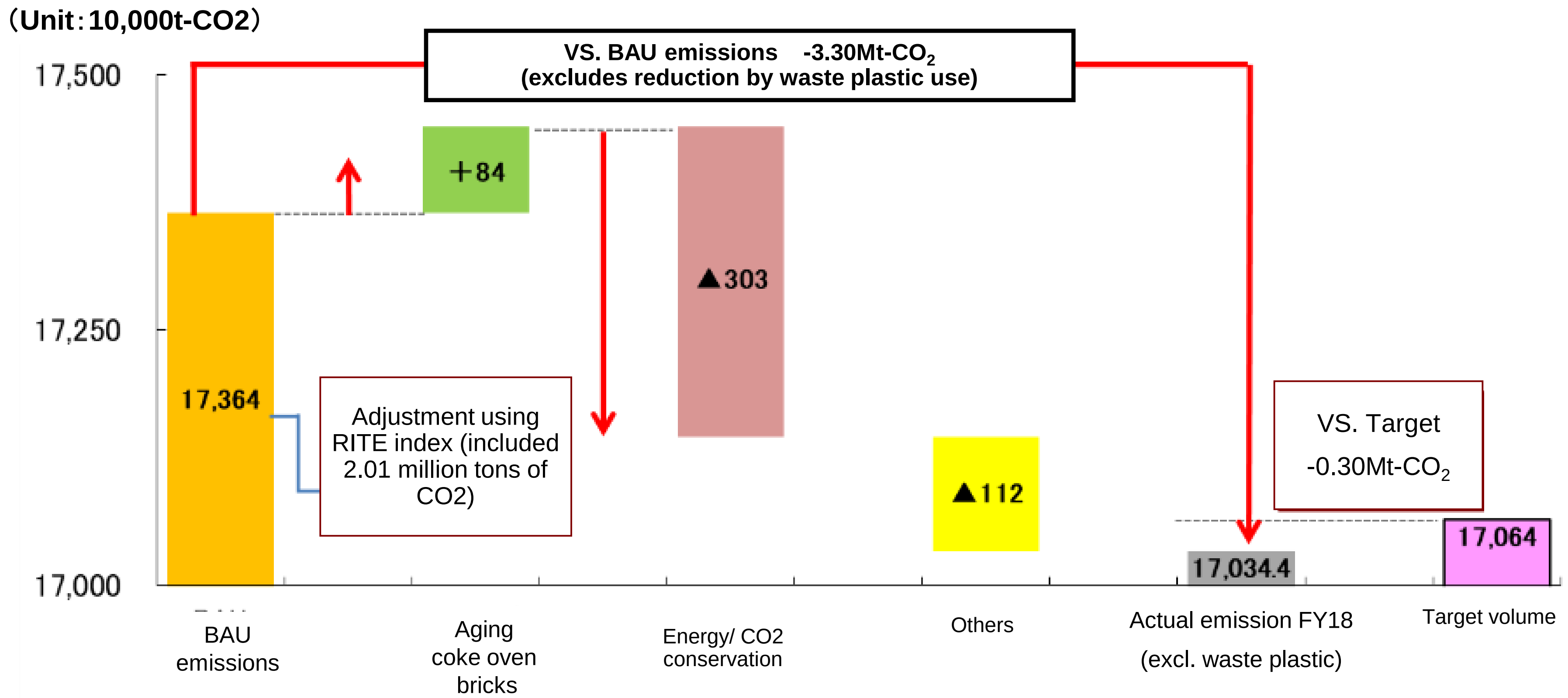


*PJ is a petajoule (10^{15} joules). One joule is 0.23889 calories. 1PJ is equivalent to about 2.58 million kiloliters of crude oil.

Components of Changes in FY2019 CO_2 Emissions

- In FY2019, CO_2 emissions were 3.30 million tons below the BAU level. Energy and CO_2 conservation measures cut emissions by 3.03 million tons, aging bricks in coke ovens raised emissions by 0.84 million tons, and other measures cut emissions by 1.12 million tons. These figures do not include changes in CO_2 emissions caused by the use of waste plastic.
- FY2019 performance overachieved FY2020 target by 300,000 t-CO2.

Progress toward 3 million ton CO_2 emission reduction due to energy conservation and other voluntary measures



※FY2019 CO_2 emissions use the FY2005 electricity coefficient.

Evaluation of FY2019 Performance

1. Progress with measures incorporated in the target ①

(Unit: 10,000t-CO_2)

	Expected target	FY 2018	FY 2019	Remarks
(1) Reductions from energy saving actions • Higher coke oven efficiency • More efficient power generation • More energy conservation	-3.00Mt	-2,73Mt	-3.03Mt	• Thanks to renewal of in-house power generation facilities, etc., the amount of reduction increased from the FY 2018 actual amount. • The expected amount of reduction, based on measures incorporated in the target, was achieved in FY 2019. *Starting FY 2018, the CO_2 reduction effects of projects for which energy conservation subsidies are granted (projects that contribute to improving unit fuel consumption, such as the use of regenerative burners) in relation to “more energy conservation” are quantified and recorded.

2. Factors affecting emissions that were unforeseen when targets were established ②

	Expected target	FY 2018	FY 2019	Remarks
Aging coke oven bricks	—	+1.01Mt	+84Mt	• CO_2 emissions increased due to deterioration of coke oven firebricks. This seems to be caused by the aged deterioration of the bricks and the effects of the Great East Japan Earthquake. • There remain factors that increase CO_2 emissions; however, JISF member companies have successively started renewing coke ovens, and as a result, the increase in the amount of CO_2 emissions has declined for two years in a row.
Other issues	—	-.42Mt	-1.12Mt	• It is difficult to pinpoint the causes of this decline. But it seems that energy conservation factors, such as operational efforts, surpassed energy waste factors. • In FY 2018, energy consumption increased due to temporary troubles, etc., decreasing the amount of reduction; however, the trouble factors were removed in FY 2019, improving the amount of reduction (emissions declined by 96M tons in FY 2017).
Total	—	+59Mt	-27Mt	

3. Progress toward targets (①+②)

	Expected target	FY 2018	FY 2019	Remarks
Reduction vs. BAU	-3.00Mt	2.14Mt	-3.30Mt	• The reduction target compared to BAU emissions, including unexpected factors, was achieved as of FY 2019. • Changes in CO_2 emissions caused by the use of waste plastic are not included.

4. Progress with using waste plastics

	Expected target	FY 2018	FY 2019	Remarks
Higher waste plastic use	—	+14Mt	0	• The capacity to collect waste plastics in FY 2019 was equivalent to that in FY 2005, and therefore, there was no change in CO_2 emissions in FY 2019.

*The previous fiscal year’s report said that the amount of CO_2 emissions in FY 2018 was 2.21 million tons lower than the BAU level. But this amount was changed in this report, partly because the unit calorific values and carbon emission factors have been revised by the government.

Coke Oven Updates

- JISF member companies have started replacing aging bricks in coke ovens, which is one cause of the increase in CO_2 emissions. Improvements at 11 coke ovens were already completed during Phase I of the Commitment to a Low Carbon Society.
- Although work has started, it will be impossible to solve all the issue of increasing CO_2 emissions in 2020 because of the limited availability of workers (coke oven construction specialists) and the high cost of updates (tens of billions of yen for each oven).

JISF Member Company Coke Oven Update Plans (Company and newspaper announcements as of Februry 2020)

(1) Completed Updating Projects (11 ovens)

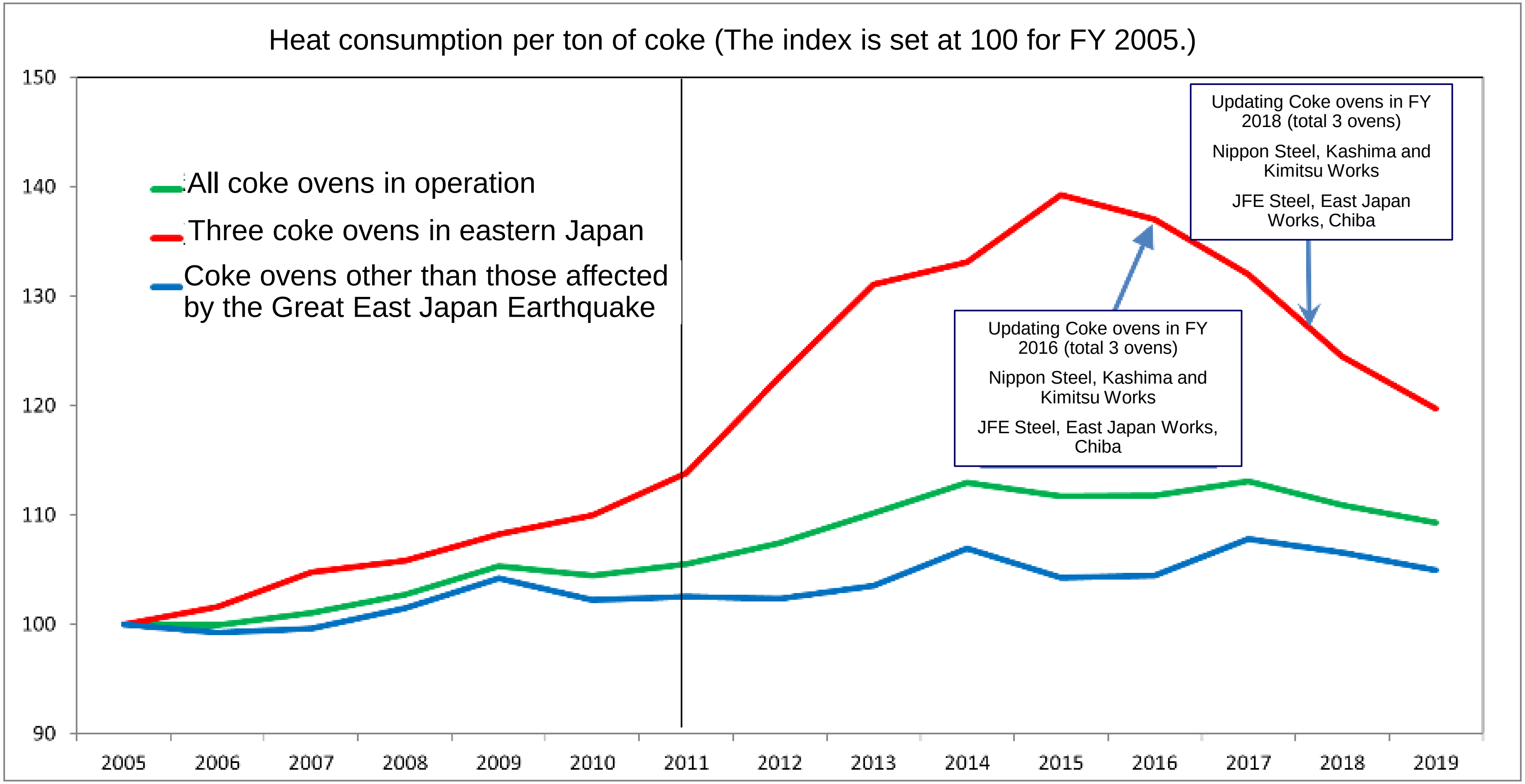
Year	Steel works	Cost
FY2013	JFE Steel, West Japan Works, Kurashiki	About ¥15 billion
FY2015	JFE Steel, West Japan Works, Kurashiki	About ¥20 billion
FY2016	Nippon Steel, Kashima Works	About ¥18 billion
	JFE Steel, East Japan Works, Chiba	About ¥11 billion
	Nippon Steel, Kimitsu Works	About ¥29 billion
FY2017	JFE Steel, West Japan Works, Kurashiki	About ¥18.4 billion
FY2018	Nippon Steel, Kashima Works	About ¥31 billion
	JFE Steel, East Japan Works, Chiba	About ¥11 billion
	Nippon Steel, Kimitsu Works	About ¥33 billion
FY2019	Nippon Steel, Muroran Works	About ¥13 billion
	JFE Steel, West Japan, Fukuyama Works	About ¥13.5 billion

(2) Planned Updating Projects (5 ovens)

Year	Steel works	Cost
FY2021	JFE Steel, West Japan Works, Fukuyama	About ¥13 billion
	Nippon Steel, Nagoya Works	About ¥57 billion

*Red projects: steel works affected by the Great East Japan Earthquake. (Red projects: FY2016 Nippon Steel, Kashima Works; FY2016 JFE Steel, East Japan Works, Chiba; FY2016 Nippon Steel, Kimitsu Works; FY2018 Nippon Steel, Kashima Works; FY2018 JFE Steel, East Japan Works, Chiba; FY2018 Nippon Steel, Kimitsu Works)

(Reference) Unit heat consumption (index) in coke ovens

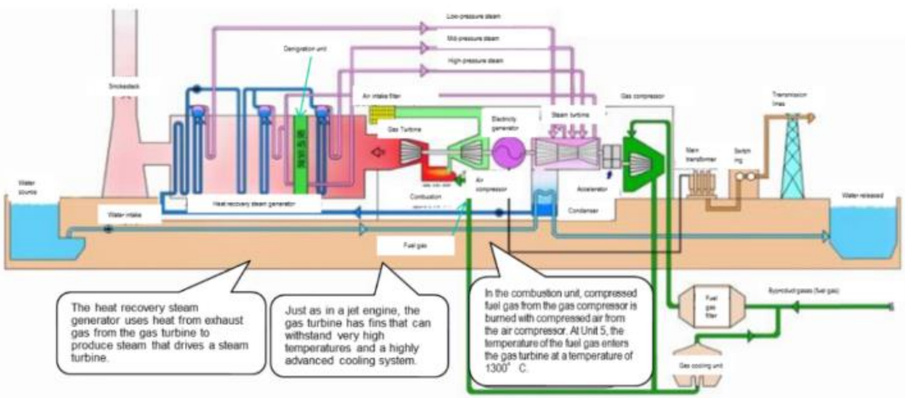


Major Initiatives implemented or planned since FY2005

1. Next generation coke ovens（Implementing SCOPE21）

	Nippon Steel, Oita Works	Nippon Steel, Nagoya Works
Implement period	2008	2013
Production capacity	About 1 million tons /year	About 1 million tons /year
Investment amount	About ¥ 37billion	About ¥ 60 billion
Expected effects	Compared to conventional coke ovens, CO2 equivalent:▲0.4 million ton / year	Compared to existing coke ovens, ▲0.1-0.2 million ton CO2 / year

Advanced Combined Cycle Power Generation



Source: Kimitsu Cooperative Thermal Power Company, Inc.

2. More efficient power

Kobe Steel Kakogawa Station No. 1
Gas turbine combined cycle unit (2011)

Kimitsu Joint Thermal Station No. 6
Advanced combined cycle unit (2012)

Kashima Joint Thermal Station No. 5
Advanced combined cycle unit (2013)

Wakayama Joint Thermal Station No. 1
Advanced combined cycle unit (2014)

Oita Joint Thermal Station No. 3
Advanced combined cycle unit (2015)

Kobe Steel Kakogawa Station No. 2
Gas turbine combined cycle unit (2015)

JFE Steel Chiba Station West-No. 4
Gas turbine combined cycle unit (2015)

Nisshin Steel Kure Power Station No. 6
Boiler, turbine and generator (planned for 2017)

JFE Steel Ohgishima Thermal Station No. 1
Gas turbine combined cycle (planned for 2019)

Fukuyama Joint Thermal Station No. 2
Gas turbine combined cycle (planned for 2020)

Introduction of AI, IoT, and other Digital Technologies

- Steelmakers are increasingly introducing AI, IoT, and other advanced digital technologies. This is expected to contribute to preventing operational troubles and stabilizing operations (energy saving).

Examples of technologies introduced by JISF member companies
(excerpted from data released by JISF member companies)

Nippon Steel Corporation

- At the No.2 blast furnace of Muroran Works, Nippon Steel introduced a system to predict conditions inside a blast furnace by using a mathematical model. AI helps automatically adjust and achieve optimal operational conditions.

JFE Steel Corporation

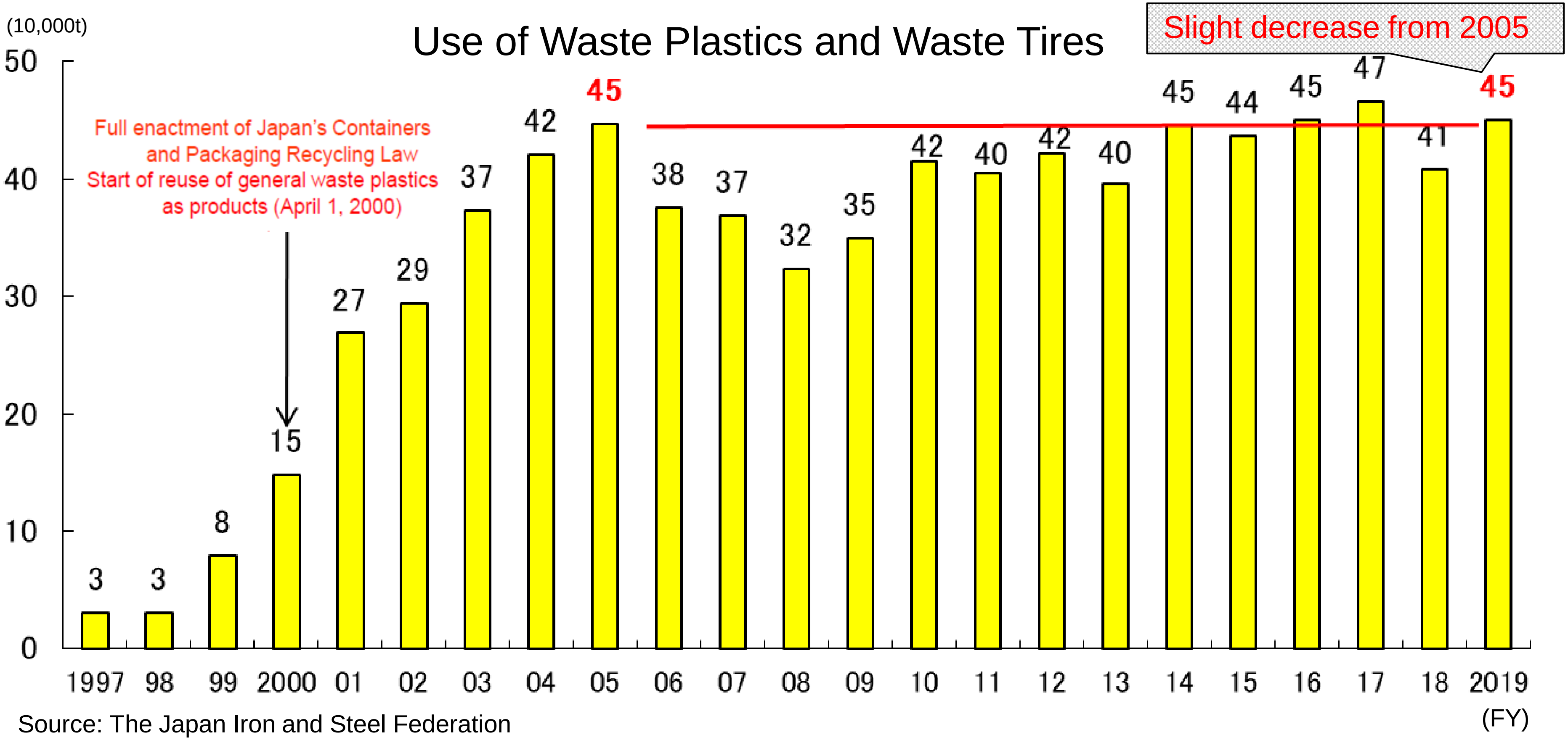
- JFE Steel introduced a data science technology at its domestic blast furnaces for the purpose of developing a cyber-physical system (CPS). This enables to detect signs of abnormality and predict conditions inside a blast furnace to achieve stable operations.

Kobe Steel, Ltd.

- At the No. 2 blast furnace of Kakogawa Works, Kobe Steel introduced a system to predict blast furnace heat levels by using AI. This enables to predict hot metal temperature automatically and highly accurately.

Use of Waste Plastics and Other Recycled Materials

- JISF's commitment to a Low Carbon Society has the goal of raising the use of waste plastics and other recycled materials to 1 million tons, assuming the government establishes the necessary collection infrastructure. However, collections totaled 450,000 tons in FY2019, unchanged from FY2005 collections of recycled materials.
- A great amount of CO_2 emission reduction is possible by reexamining associated policies for the use of waste plastics and other materials. At government councils and other opportunities, JISF constantly ask for reviews of the current recycling system and revisions as soon as possible.

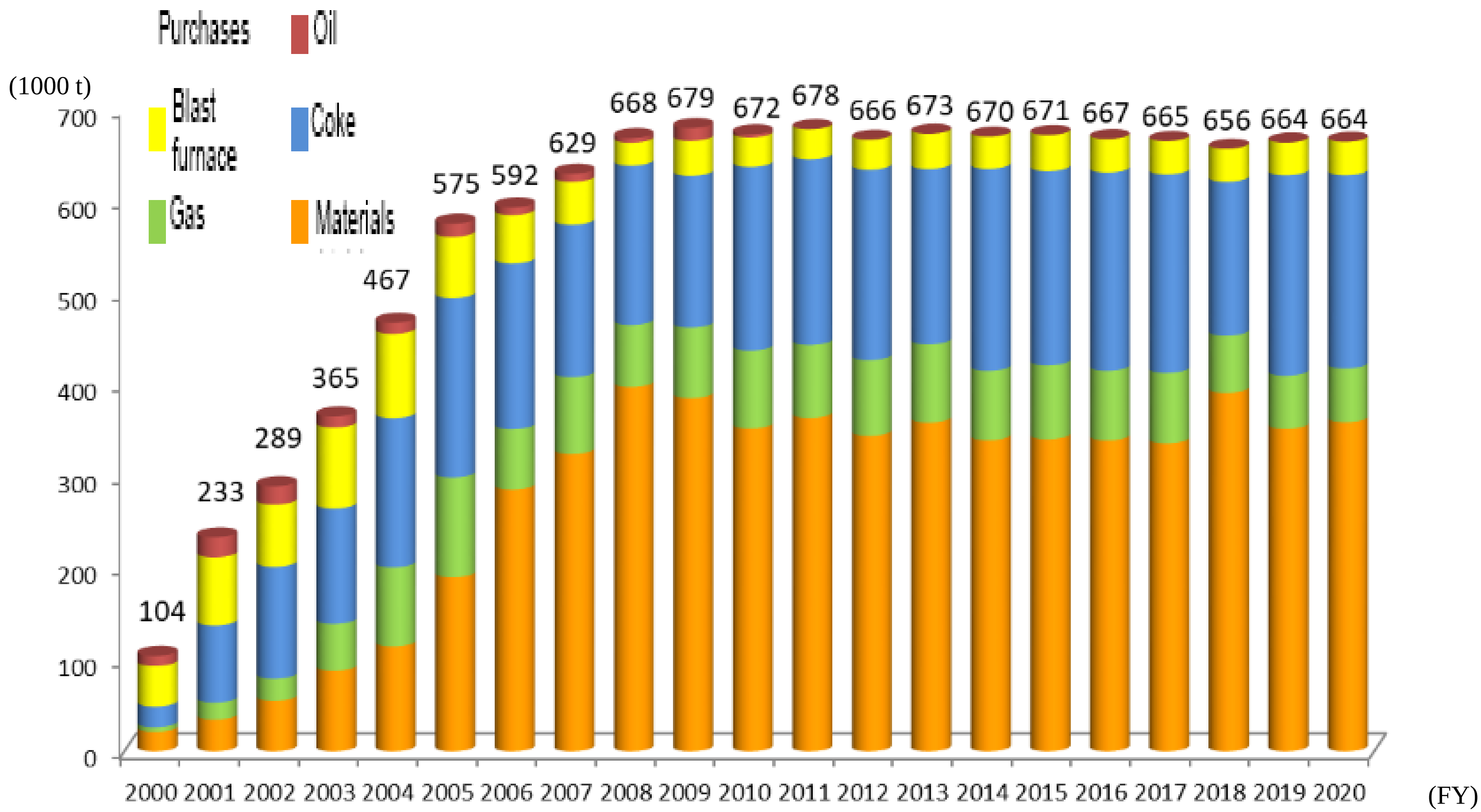


Source: The Japan Iron and Steel Federation

Current status of chemical recycling

- As for the procurement of plastic packaging and containers, priority is given to material recycling, and therefore, the quantity of plastic packaging and containers bid for and purchased for chemical recycling (using blast furnaces or coke ovens) is showing little growth.
- The bidding system was revised in FY 2018, enabling companies that fail to successfully bid for and purchase plastic packaging and containers designated specifically for material recycling can now bid for plastic packaging and containers designated for general purposes (chemical recycling, etc.). In FY 2019, the quantity of plastic packaging and containers bid for and purchased for chemical recycling increased slightly from FY 2018, but remained at a level similar to that in previous years.

Volume Purchased and Unit Price by Method for Recycling Container and Packaging Plastics



Source: The Japan Containers and Packaging Recycling Association

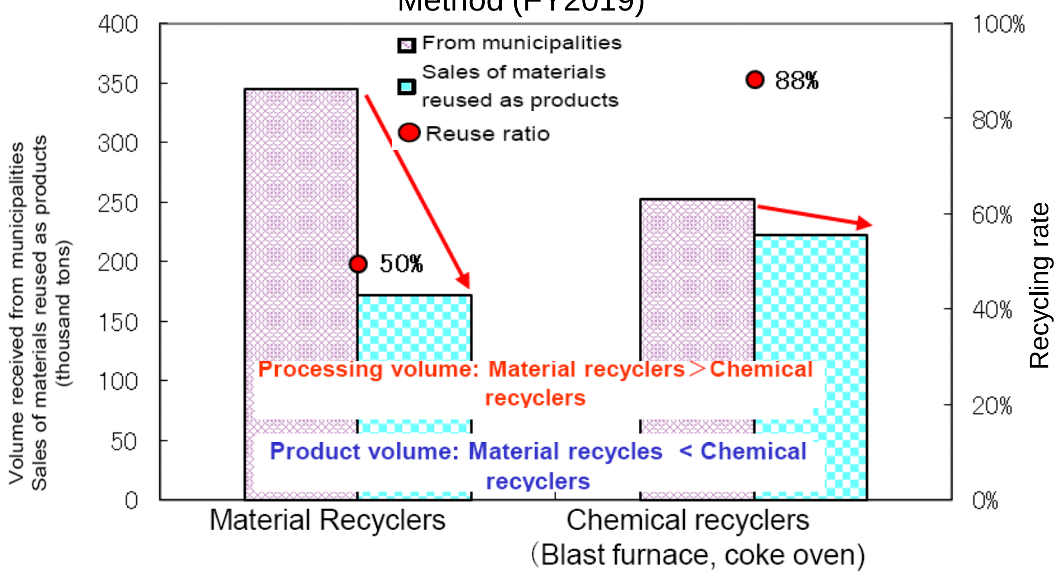
For expansion of chemical recycling

- Chemical recycling produces fewer residues than material recycling, and under chemical recycling, almost the whole of materials is recycled. In addition, unit contract prices are low (this means that the recycling-related social cost is low). Chemical recycling is an excellent recycling method.
- Currently, steelmakers can process about 300,000 tons of plastic packaging and containers by using their steel production processes.
- To efficiently promote recycling, it is necessary to promptly revise the existing structure from the following viewpoints.

①From the standpoint of efficiently and effectively using waste materials (recycling waste materials that are highly effective at cutting CO_2 emissions and have a low social cost), the container and packaging recycling system should stop placing priority on recycling materials that produce only small reductions in CO_2 emissions.

②Collection of waste materials should not be restricted to items covered by the Container and Packaging Recycling Law; collecting product plastic waste and other materials also could reduce the need for consumers to discard trash by category and reduce the trash classification expenses for local governments. The government should thus consider expanding recycling activities to include more types of materials. It is also necessary to consider establishing a pickup system, a quality guarantee system on a par with those stipulated in the Containers and Packaging Recycling Law.

Materials Received, Products Sold and Reuse Ratio by Method (FY2019)



Source: The Japan Containers and Packaging Recycling Association

Unit contract price by method of recycling (weighted average)

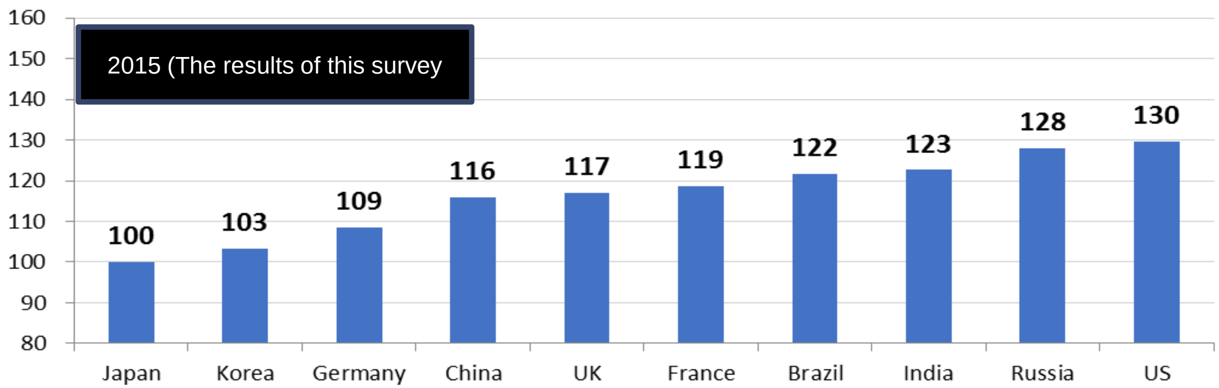
Unit: ￥, %

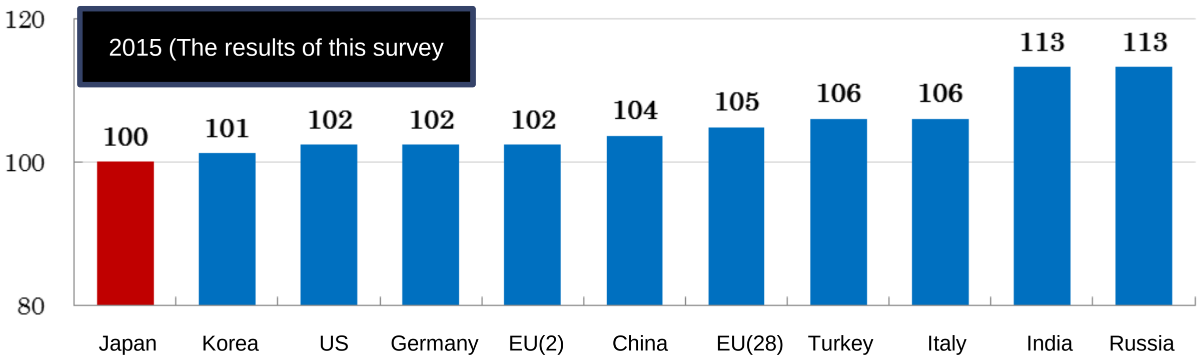
Fiscal year	Material	Chemical	Material/Chemical
FY2000	109,300	94,200	86.2
FY2005	109,300	73,000	66.8
FY2010	74,498	38,646	51.9
FY2011	71,583	37,631	52.6
FY2012	69,789	40,481	58.0
FY2013	66,401	41,561	62.6
FY2014	63,377	43,546	68.7
FY2015	59,561	44,991	75.5
FY2016	50,652	41,326	81.6
FY2017	54,897	45,210	82.4
FY2018	54,945	43,336	78.9
FY2019	56,406	40,078	71.1
FY2020	58,211	46,743	80.3

Japan's steel industry (BF-BOF･EAF) maintains the world's highest energy efficiency

- The Research Institute of Innovative Technology for the Earth (RITE) issued an report in 2018 on international comparison of energy efficiency level in steel industry (BF-BOF*). The report revealed that Japan maintains the world's highest energy efficiency in 2015, as in 2005 and 2010.

Estimate of Steel Industry (BF-BOF) Energy Efficiency (2015, Japan=100)





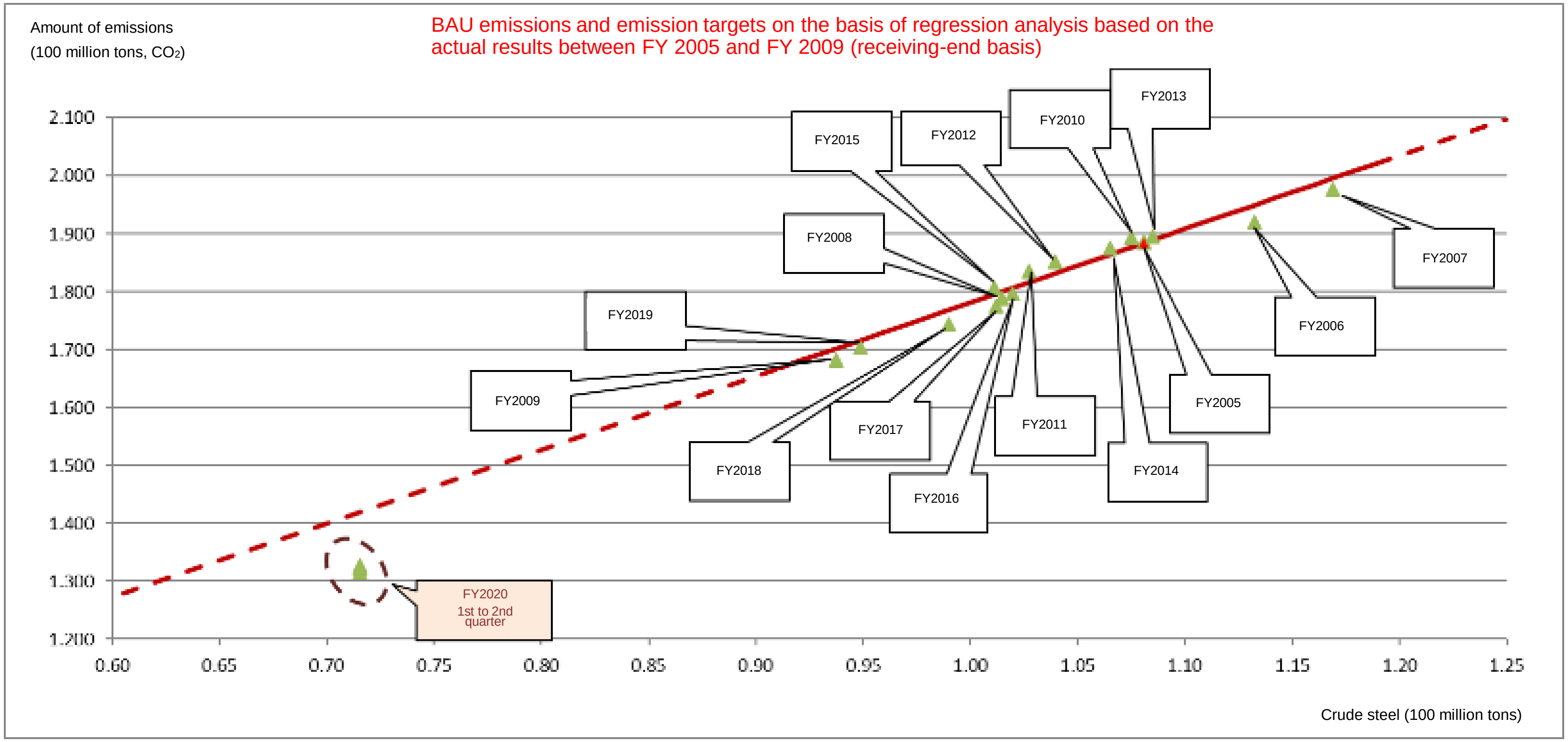
Why is Japan's steel industry the most efficient?

- The **penetration rate of energy-saving technologies** is very high in Japan's steel industry.
- Steelmakers are working on achieving the goals of the JISF's Commitment to Low Carbon Society and **sharing best-practice knowledge** among themselves.

In addition to actions in Japan, increasing the use of energy-saving measures and technologies worldwide will be an effective way to further lower CO_2 emissions in the steel industry.

Status of JISF's Commitment to a Low Carbon Society in FY2020

- To achieve the Phase I target, JISF are tracking the progress on a quarterly basis from the 2nd half of 2019.
- Nationwide crude steel production in FY 2020 stands at about 80 million tons, far lower than that of FY 2019. Under extremely unusual circumstances where furnaces suspend blasting on a large scale, the current blast furnace operations seem to be showing discontinuity from those until FY 2019.
- Until FY 2019, crude steel production was within the range between 93.72 million tons and 116.89 million tons (the range difference was about 20 million tons), and the BAU line and its pig iron ration adjustments were appropriate.
- The current BAU line is a linear function developed from regression analysis based on the actual results between fiscal 2005 and FY 2009 (the production range: 96.45 million tons - 121.51 million tons for crude steel produced nationwide, and 93.72 million tons - 116.89 million tons for crude steel produced by the participating companies). (Linear function: y=1.271x+0.511)
- For reference, if the current BAU line is extended to the latest production level, and this is evaluated in comparison with BAU emissions on the basis of the estimated amount for the period between April and September, the result is far higher than the reduction target compared to BAU emissions (3 million tons). There is discontinuity from previous years.



Evaluation of the Phase I Target (FY 2020 Target)

- As mentioned below, the circumstances of FY 2020 are showing discontinuity from those until FY 2019, reflecting the COVID-19 outbreak, and it is difficult to conduct appropriate evaluation based on the BAU line.

  (1) Steel production in FY 2020 declined sharply due to the effects of the COVID-19 outbreak, and the current operations are showing discontinuity from those until FY 2019.

  (2) The level of production deviates sharply from the production range assumed at the time of setting the current BAU line (between 93.72 million tons and 116.89 million tons for crude steel produced by the participating companies), and the current operational circumstances are different from those in the past. Therefore, the appropriateness of evaluation in comparison with BAU emissions cannot be secured.

  (3) The production level in any of the 30 years from FY 1990 is not close to the FY 2020 level, and it is difficult to set a new BAU line within this production range.

- In view of these situations, the level of achievement of the Phase I target should be evaluated based on the actual results of FY 2019, which are the latest results that can be used to conduct appropriate evaluation on the basis of the current BAU line, instead of the actual results of FY 2020.
- It is difficult to use the actual results of FY 2020 for appropriate evaluation on the basis of the current BAU line, but the amount of actual emissions and the steel industry's activities for FY 2020 will be reported as usual.

About the Phase II Target (FY 2030 Target)

- The current Phase II target (the 2030 CO_2 emissions reduction target compared to BAU emissions (a reduction of 9 million tons)) is also based on the same BAU line. But the production structure will be changed due to the suspension or closure of coke ovens, blast furnaces, and other facilities starting from 2021, and operational continuity will be lost. Consequently, it will be necessary to consider revising the Phase II target, in view of the possibility that it may become impossible to manage the target on the basis of the current BAU line.

(Reference) List of Blast Furnaces Banked, Suspended due to COVID-19

(as of February 2021; prepared based on data released by steelmakers and news reports)

Time of suspension	Time of resumption of operation	Steelworks name	Blast furnace name	Remarks
Feb, 2020	-	Nippon Steel Setouchi Works, Kure Area	No. 2 blast furnace	The blast furnace will be officially closed by the end of the first half of FY 2021.
Apr, 2020	Jan, 2021	Nippon Steel East Nippon Works, Kashima Area	No. 1 blast furnace	
Apr, 2020	-	Nippon Steel Kansai Works, Wakayama Area	No. 1 blast furnace	The blast furnace will be officially closed in the first half of FY 2022.
Apr, 2020	-	JFE Steel West Japan Works, Kurashiki	No. 4 blast furnace	The blast furnace was suspended because its renewal schedule was moved up.
June, 2020	Nov, 2020	Nippon Steel East Nippon Works, Kimitsu Area	No. 2 blast furnace	
June, 2020	Sep, 2020	JFE Steel West Japan Works, Fukuyama	No. 4 blast furnace	
July, 2020	Nov, 2020	Nippon Steel Muroran Works	No. 2 blast furnace	The blast furnace was suspended because its renewal schedule was moved up.
July, 2020	-	Nippon Steel Kyushu works, Yawata Area	Kokura No. 2 blast furnace	The blast furnace was closed ahead of the original schedule.

(Reference) List of Blast Furnaces and Coke Ovens to be Closed
(as of February 2021; prepared based on data released by steelmakers)

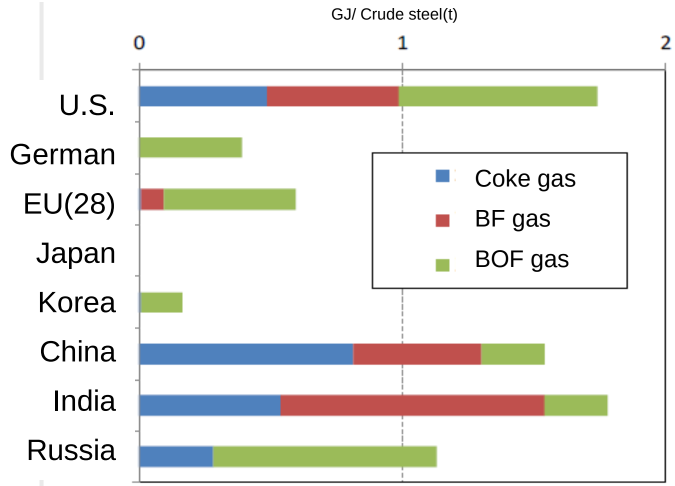
Scheduled time of closure	Steelworks name	Blast furnaces and coke ovens to be closed
By the end of the first half of FY 2021	Nippon Steel Setouchi Works, Kure Area	Blast furnaces 2 → 0 (Closure of No. 1 and No. 2 furnaces)
In the first half of FY 2022	Nippon Steel Kansai Works, Wakayama Area	Blast furnaces 2 → 1 (Closure of No. 1 furnace) Coke ovens 3 → 1 (Closure of No. 4 and No. 5 ovens)
In FY 2023	JFE Steel East Japan Works, Keihin	Blast furnaces 1 → 0 (Closure of No. 2 furnace) Coke ovens 2 → 0 (Closure of No. 1 and No. 2 ovens)

2. Eco Solution

Eco Solution: CO_2 Emission Reduction from Increasing Use of Technologies

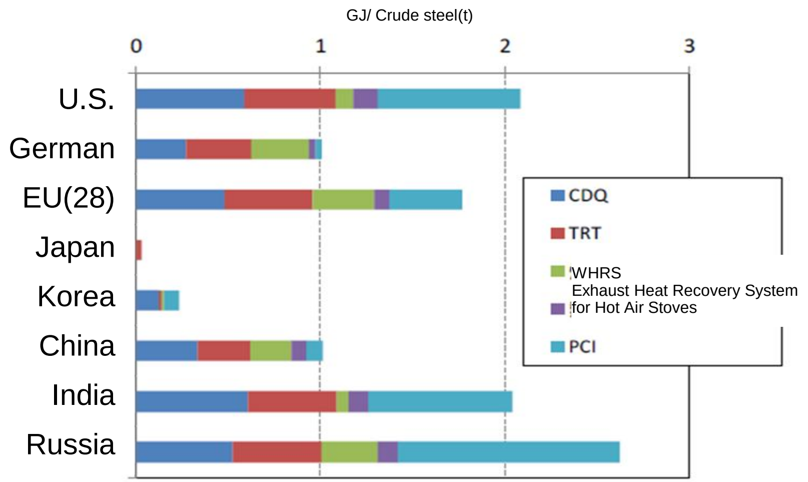
- There is much potential for increasing the use of major energy conservation technologies globally, especially in India where steel production is expected to continue to grow.
- Major energy conservation technologies developed and used in the Japanese steel industry are already lowering CO_2 emissions overseas as Japanese companies provide these technologies to other countries. CDQ, TRT and other major types of equipment alone are already lowering annual aggregate CO_2 emissions in China, Korea, India, Russia, Ukraine, Brazil and other countries by 68.57million tons.

Results of potential evaluation for the recovery and efficient use of by-product gases (2015)



(Source) This was estimated by RITE on the basis of the IEA energy balance table (for 2017).

Energy conservation potential through the spread of major energy conservation technologies



(Source) This chart was created by referring to Arens et al. (2017) for Germany, JISF (2017) for Japan, Schulz et al. (2015) for South Korea, and China Steel Yearbook (2016) for China.

Emission Reductions in Other Countries from Japanese Energy-conserving Equipment (FY2019)

	No. of units	Reduction
Coke dry quenching (CDQ)	114	22.96
Top-pressure recovery turbines (TRT)	65	11.50
Byproduct gas combustion (GTCC)	56	24.02
Basic oxygen furnace OG gas recovery	22	8.21
Basic oxygen furnace sensible heat recovery	8	0.90
Sintering exhaust heat recovery	7	0.98
Total emission reduction		68.57Mt

Ref: Total emission reduction in FY2017 was 65.53Mt - CO_2/year

※CDQ : Coke Dry Quenching
TRT : Top Pressure Recovery Turbines
GTCC : Gas Turbine Combined Cycle system

International Collaboration for the Support of Eco Solutions

2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

Bilateral Activities

Japan-China Steel Industry Environmental Protection and Energy Conservation Technology Conference (2005~)

The Public and private collaborative meeting between Indian and Japanese Iron and Steel Industry (2011~)

ASEAN-Japan Steel Initiative (2014~)

Multilateral Activities

APP Steel TF (2006~2010)
APP: Asia Pacific Partnership

GSEP Steel WG(2010~2015)
GSEP: Global Superior Energy Performance Partnership

worldsteel etc.

ENCO (~2009)
Environment Committee

EPCO (2010~2013)
Environmental Policy Committee

ECO (2014~)
Environment Committee

“CO_2 Breakthrough Program”: Participating with COURSE50 (2003~)

CO_2 data collection (2007~)

Development of ISO14404* (2009~)
Versions for integrated steel plants and EAF issued in 2013, version for DRI-EAF in 2017 and version for all types of process in 2020
*International standard for the calculation of CO_2 emission from steel plants

2020 AJSI Webinar
Energy-Efficient and Environmental Transition towards Sustainable Steel Industry

Outline

Schedule: December 14, 2020 (3 hours)
Location: Online
Participants from seven ASEAN countries*: Ministries and agencies related to steel and energy conservation and steel industry organizations and their member companies**
Participants from Japan: Ministry of Economy, Trade and Industry, JISF and its member companies, etc. (**over 200 people**)

*: Myanmar, Thailand, Malaysia, the Philippines, Vietnam, Indonesia, Singapore
**: Persons in charge at energy conservation-related divisions, engineering divisions, marketing divisions, accounting divisions, etc. participate in the seminar.

Seminar details

- ✓ Japanese participants presented **energy saving technologies and case study of energy saving**, and Thai participants presented **examples relating to Japan's past support**.
- ✓ In the ASEAN region, steel is produced mainly at electric furnaces, and many companies do not have or have suspended electric furnaces and hot strip production facilities. Therefore, the seminar also actively dealt with **examples small-scale technologies and operational improvement with low-cost**.

Viewpoint	Examples and technologies
Short-term improvement	- Case study of cost and energy saving by Japanese electric furnace makers - Representative technologies relating to electric furnace energy conservation and examples of operational improvement - Presentation of energy conservation technologies for electric furnaces by technology suppliers
Medium- to long-term improvement	- Outline of the Joint Crediting Mechanism (JCM) - ISO14404, which specifies calculation methods for CO_2 emissions at steelworks - Examples of CO_2 emission benchmarking activities in Thailand - Latest policies and technology trends for achievement of sustainable growth of the steel industry

Evaluation by participants

- ✓ **There were high marks for the presentation of examples of efforts for operational improvement that can be implemented even during the COVID-19 pandemic and low-cost technologies for energy conservation.**
- ✓ **Also regarding technological and policy-related initiatives for achievement of low-carbon or zero-carbon production in the steel industry on a long-term basis, there are high expectations for the provision of information and cooperation by the Japanese steel industry.**

*Excerpted from surveys conducted after the seminar

Evaluation by the SEAISI

- ✓ On its website, the SEAISI* reported the outline of the webinar and expressed its gratitude to Japanese participants and others.

SEAISI* South East Asia Iron And Steel Institute
Source: SEAISI NEWSLETTER (January 5, 2021) https://seaisi.org/newsletter

3. Eco Product

Eco Product: Japanese Industrial Products that Conserve Energy and Cut CO_2 Emissions

- Japanese manufacturers have taken the lead in developing and commercializing many highly efficient industrial products. Examples include fuel-efficient automobiles and highly efficient power generation equipment and transformers. These products have made a big contribution to conserving energy and cutting CO_2 emissions in Japan and worldwide.
- The Japanese steel industry has established a close relationship with these manufacturers by developing and supplying steel that has a variety of characteristics. This high-performance steel is vital to achieving the outstanding functions of advanced products and has earned a reputation for reliability among manufacturers.

➢Airplane components

Strong and durable jet engine shafts further boost maximum thrust = Longer range, better fuel efficiency

➢Motors for hybrid/electric cars

High-efficiency non-oriented electrical sheets for higher fuel efficiency, more power, smaller size and lower weight

➢Automotive and industrial machinery parts

Strong gear steel increases gears and reduces size and weight – higher fuel efficiency

➢Boiler tubes

Steel tubes that resist high temperatures and corrosion make power generation more efficient

➢Suspension springs

Higher strength steel for valve and suspension springs used in punishing applications makes vehicles lighter and lowers fuel consumption

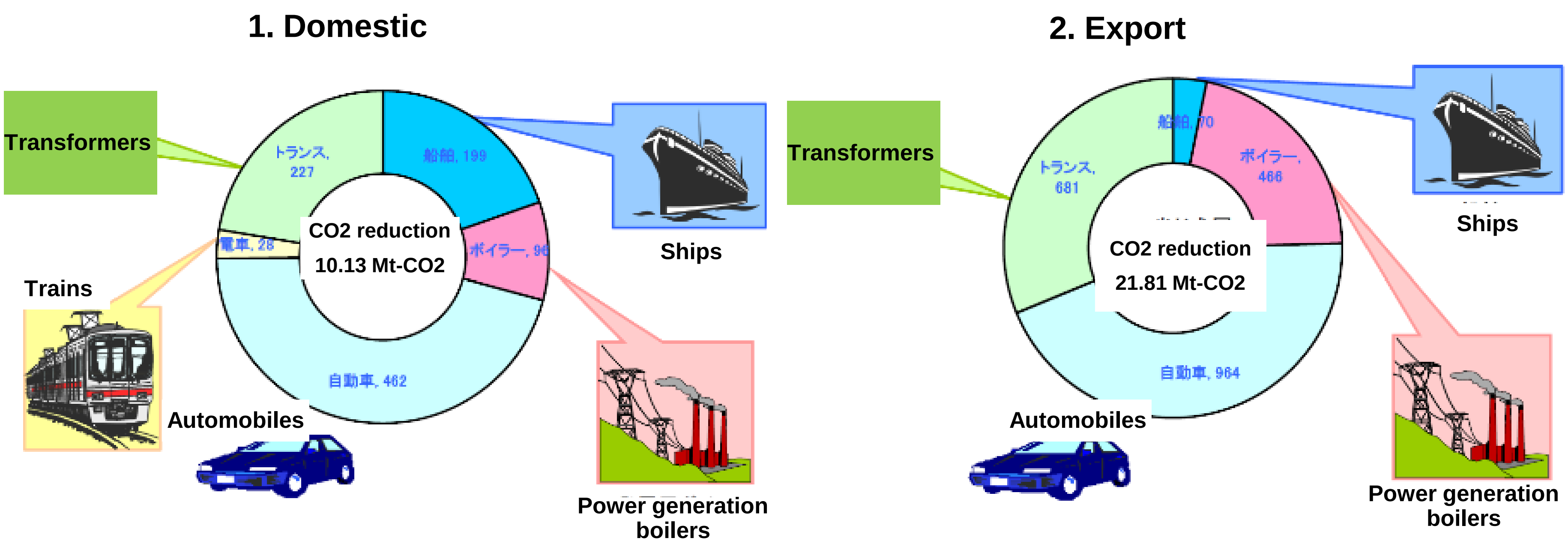
➢Generator parts

Steel for high-efficiency power plant turbines can withstand high temperatures and high rotation speeds

Eco Product Contribution: Quantitative Evaluations – Contributions of Major High-performance Steel Products

- To establish a method to determine the quantitative contribution of high-performance steel, JISF established in FY2001 a committee with the participation of associations of steel-consuming industries, The Institute of Energy Economics, Japan and the Japanese government. The committee has been monitoring contributions every year since then.
- Statistics are for the five major types of high-performance steel for which quantitative data are available (FY2019 production of 7.06 million tons, 7.2% of Japan's total crude steel output). The use of finished products made of high-performance steel cut FY2019 CO_2 emissions by 10.13 million tons for steel used in Japan and 21.81 million tons for exported steel, a total of 31.94 million tons of CO_2.

CO_2 Emission Reductions by the five major types of high-performance steel (FY2019)



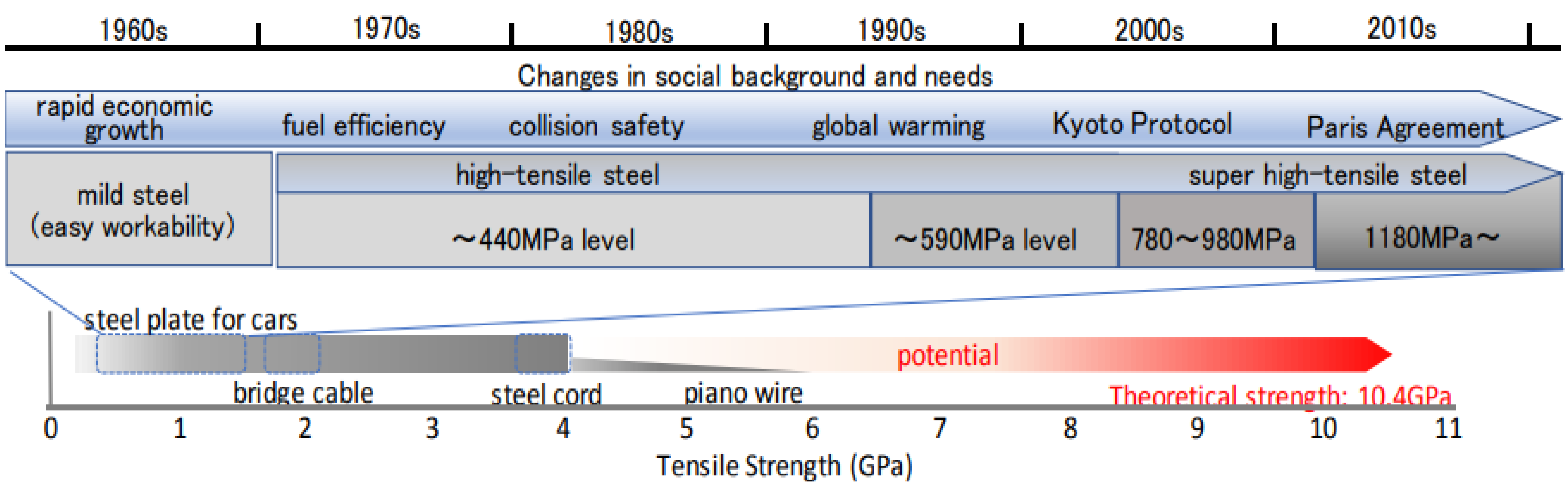
CO_2 Emission Reductions: 31.94 million tons CO_2 in total (7.06 million tons of high-performance steel)

Ref:
CO_2 Emission Reductions: 31.06 million tons CO_2 by the end of FY2018 (6.97 million tons of high-performance steel)

Source: The Institute of Energy Economics, Japan
*The five categories are automotive sheets, oriented electrical sheets, heavy plates for shipbuilding, boiler tubes and stainless steel sheets. In FY2019, use of the five categories of steel products in Japan was 3.62 million tons and exports were 3.44 million tons for a total of 7.06 million tons.
*Assessments in Japan started in FY1990 and for exports assessments started in FY2003 for automobiles and shipbuilding, in FY1998 for boiler tubes, and in FY1996 for electrical sheets.

Eco Product Contribution: Future Potential of Steel Products

- Steel products have greatly improved their mechanical and electromagnetic properties. However, the characteristic level we put into practical use is only 1/10-1/3 (in the case of strength) with respect to the theoretical limit value.
- The Japanese steel industry will contribute to the reduction of CO_2 in the entire life cycle, while supporting the foundation of the future society, through not only further strengthening steel products but also developing next-generation steel products for hydrogen infrastructure to be expected in the future.

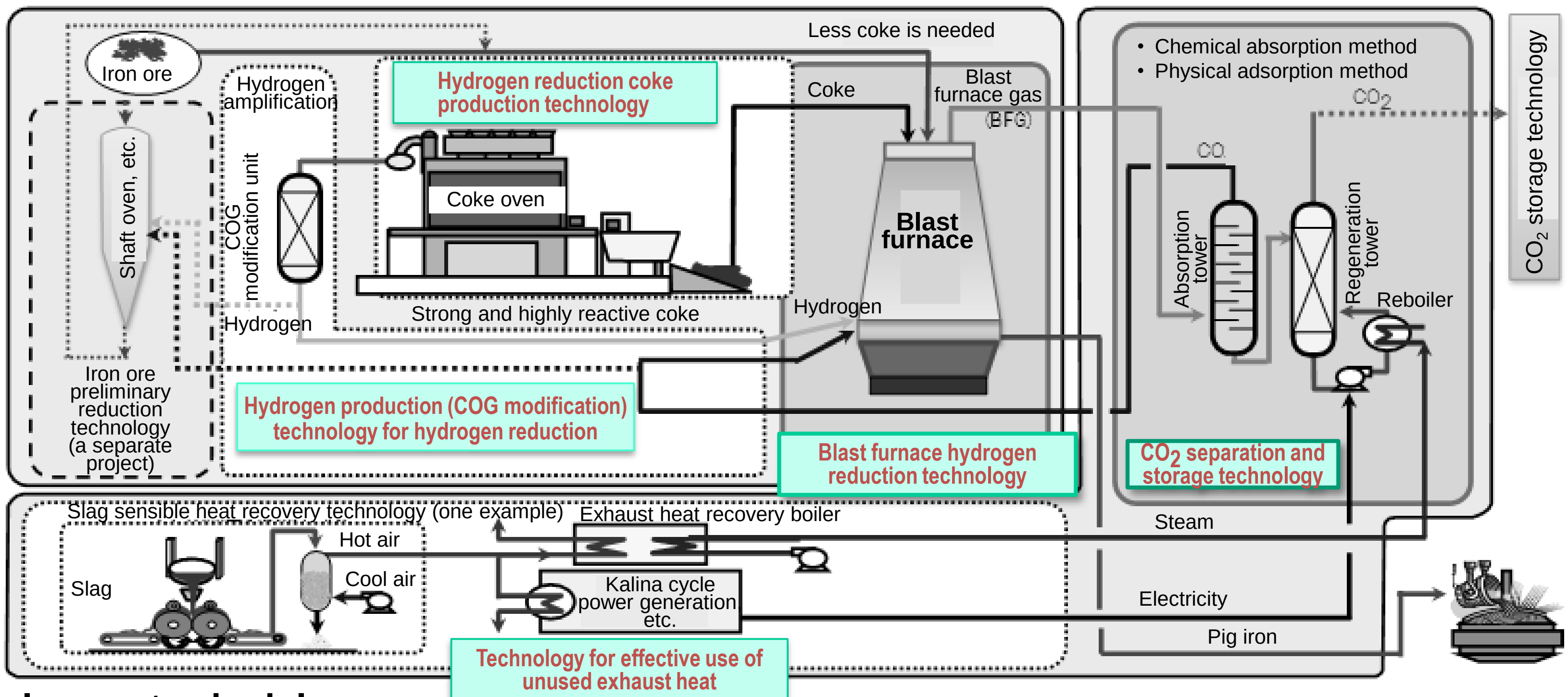


4. Promotion of CO_2 Ultimate Reduction System for Cool Earth 50 Development (COURSE50)

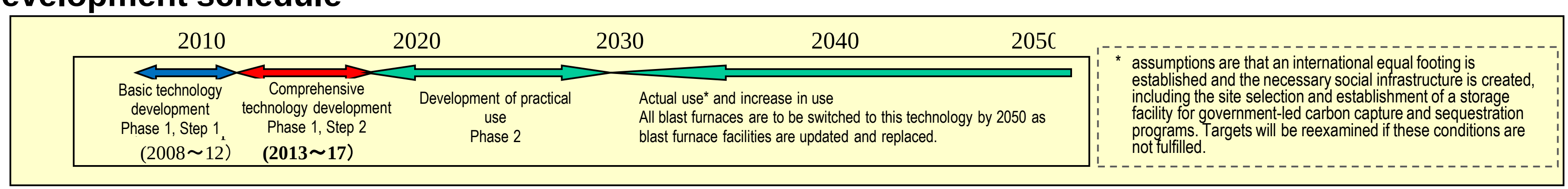
Development of CO_2 Ultimate Reduction System for Cool Earth 50 (COURSE50)

Project summary

Work is underway on developing technology for using hydrogen for the reduction of iron ore (method for lowering blast furnace CO_2 emissions). Hydrogen in the very hot coke oven gas (COG) generated during coke production is amplified and then used to replace some of the coke. Furthermore, for the separation of CO_2 from blast furnace gas (BFG), a revolutionary CO_2 separation and collection technology (technology for separating and collecting CO_2 from blast furnaces) will be developed that utilizes unused heat at steel mills. The goal is to use these technologies for low-carbon steelmaking that cuts CO_2 emissions by about 30%. (NEDO-commissioned project)



Development schedule

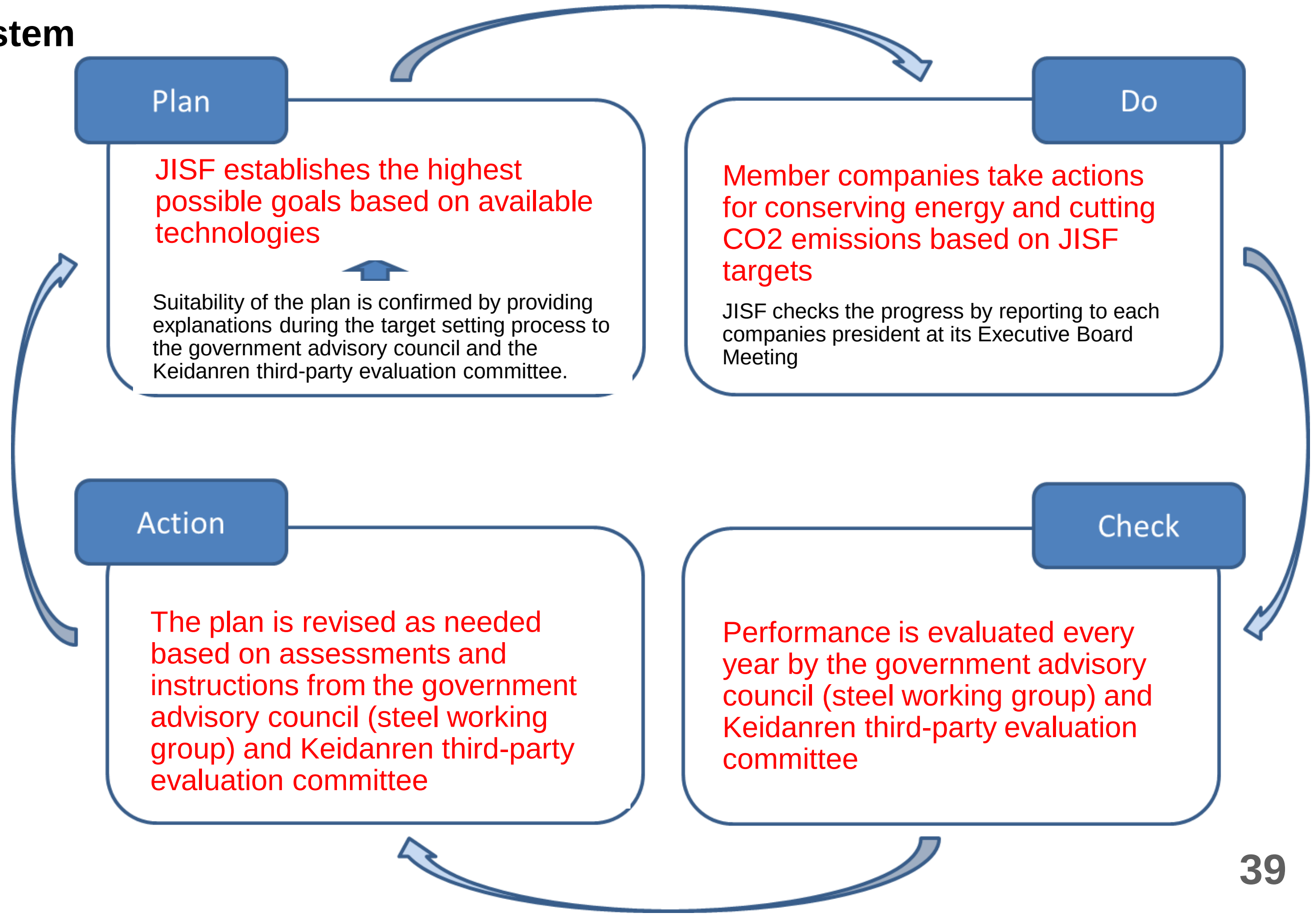


5. Reference

Eco Solution: ISO50001 Certification

- ISO50001 is an international standard for energy management systems that was issued in June 2011.
- On February 20, 2014, JISF became the first industrial association in the world to receive ISO50001 certification, the result of global warming and energy conservation measures associated with the voluntary action plan and the Commitment to a Low Carbon Society.
- This certification is proof that the voluntary actions of the steel industry are sufficiently transparent, reliable and effective in relation to the requirements of international standards.

JISF Energy Management System

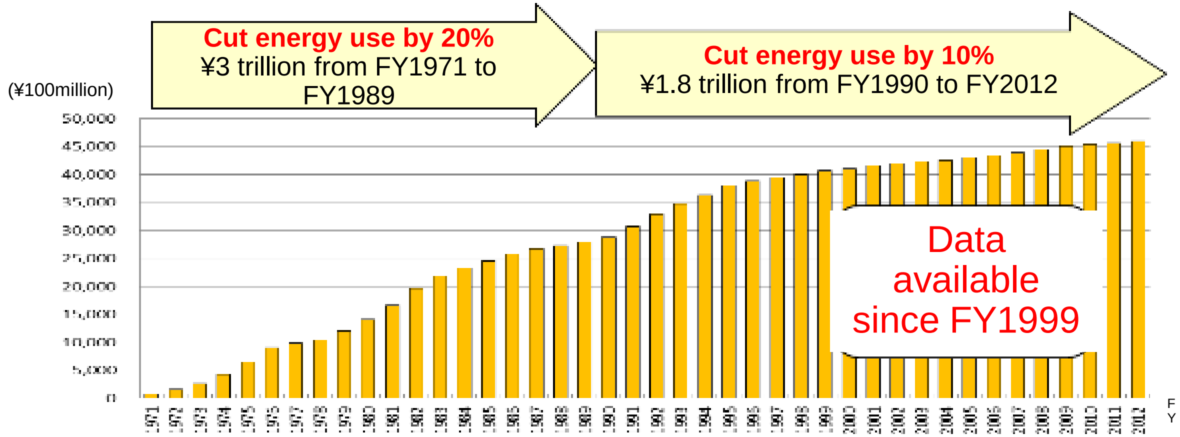


ISO50001 Certificate

Investments for Environmental Protection and Energy Conservation

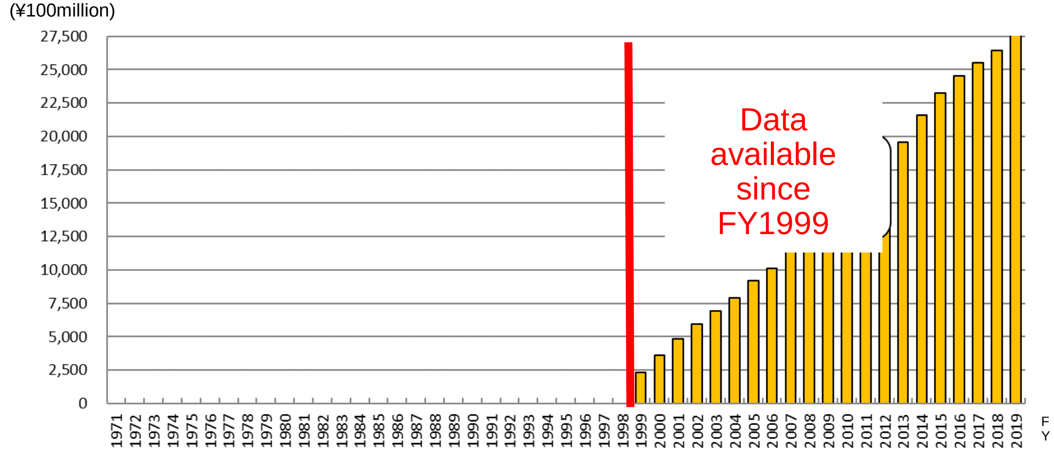
- The Japanese steel industry made investments of about ¥3 trillion between FY1971 and FY1989 for environmental protection and energy conservation. These investments totaled about ¥1.8 trillion between FY1990 and FY2012.
- Investments for rationalization and labor-saving totaled about ¥2.0 trillion between FY2005 and FY2019.

Fig. Accumulative investment for environmental facilities since FY1971



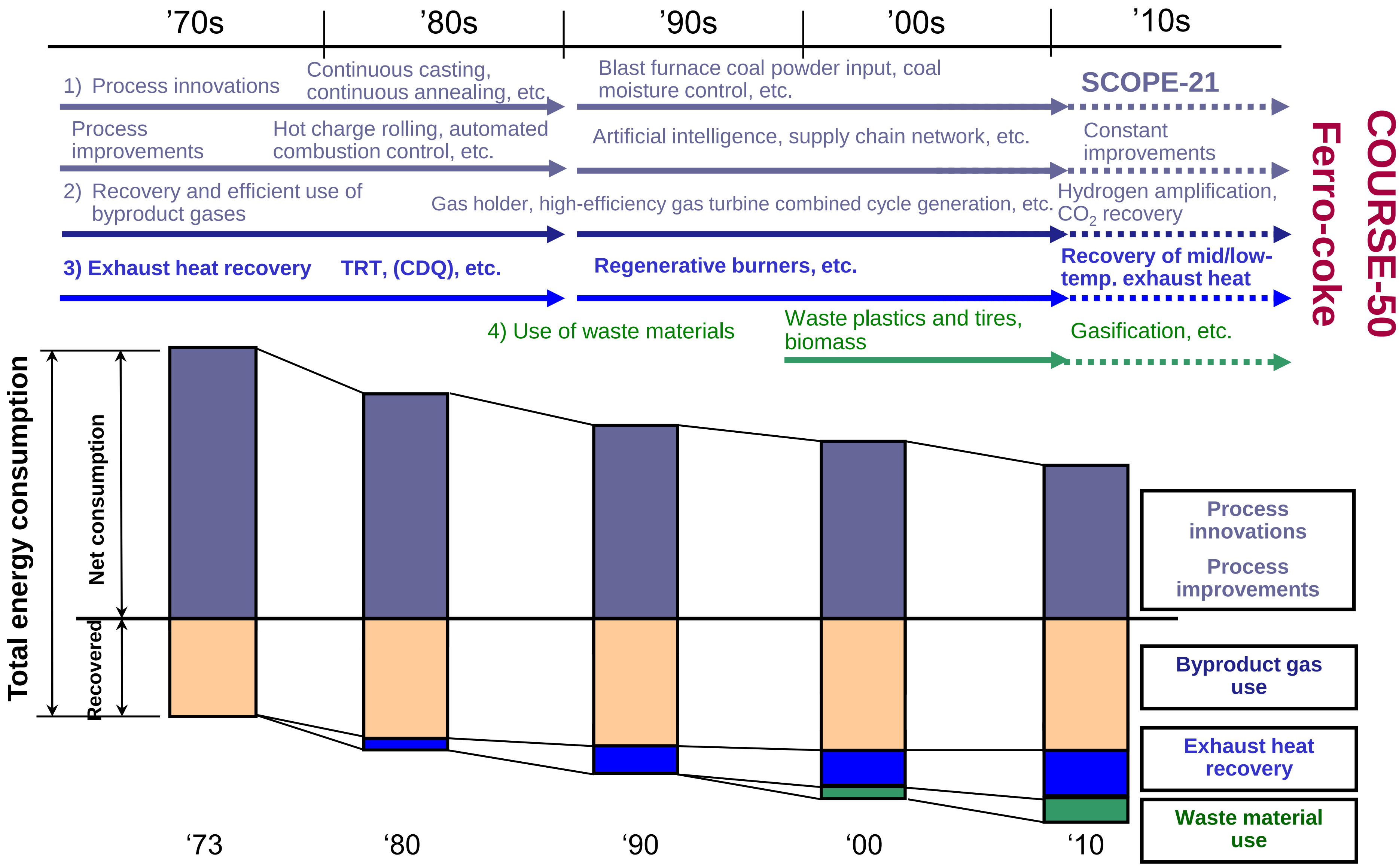
Source: ~FY2011: METI Survey on Capital Investments of Major Industries, FY2002~: METI Survey on Corporate Finance (former Survey on Capital Investments)

Fig. Accumulative investment for rationalization and labor-saving since FY1999



Source: Development Bank of Japan Inc

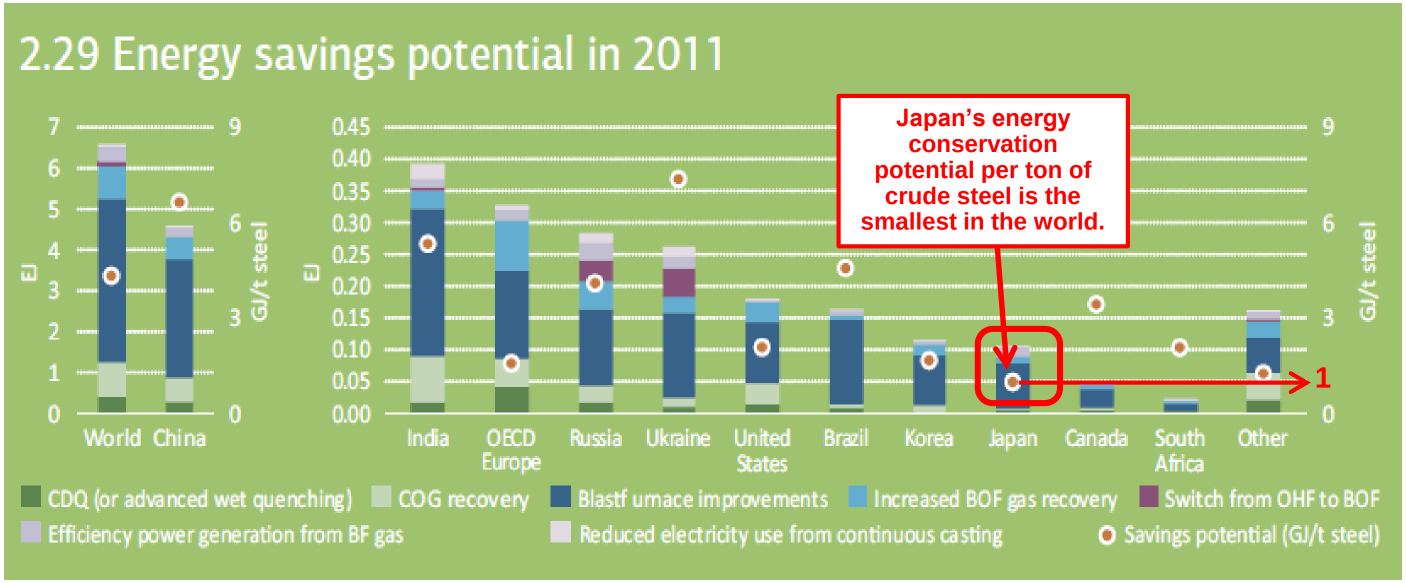
Energy Conservation Initiatives of the Steel Industry



International Comparison of Energy Efficiency in the Steel Industry

- According to the IEA, Japan has the world's smallest potential for energy conservation per ton of crude steel. According to RITE, Japan has the world's most energy efficient steel industry. These figures demonstrate that virtually all steel mills in Japan use existing technologies and that there is very little potential for further energy-conservation measures.

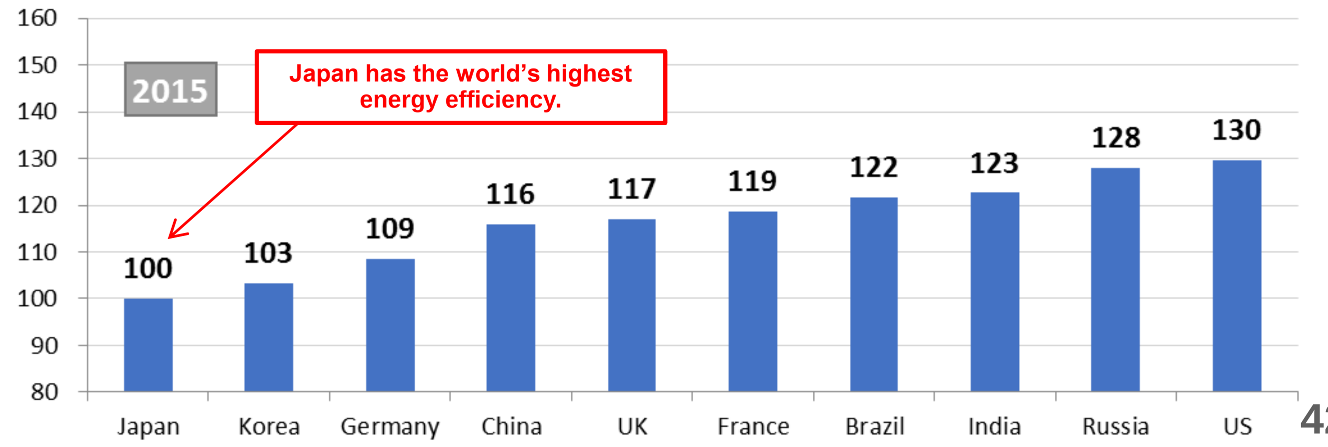
Energy Saving Potential from Transferring and Promoting Energy Conservation Technologies (2011)



Source: IEA "Energy Technology Perspective 2014"

Estimate of Steel Industry (BF-BOF) Energy Efficiency

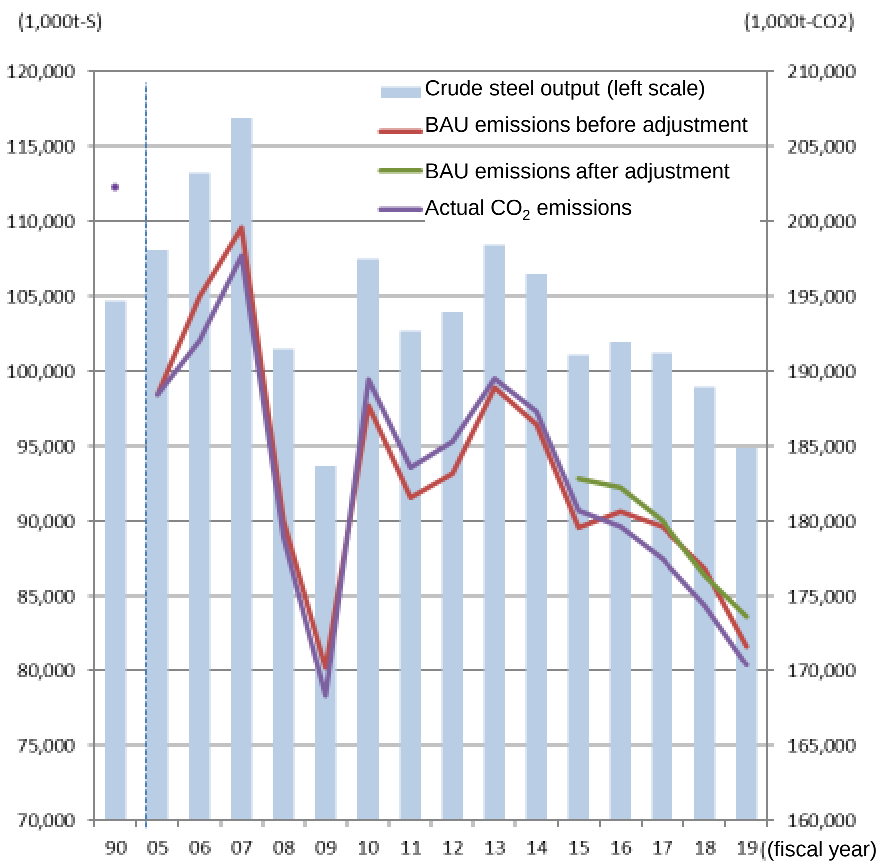
(2015, Japan=100)



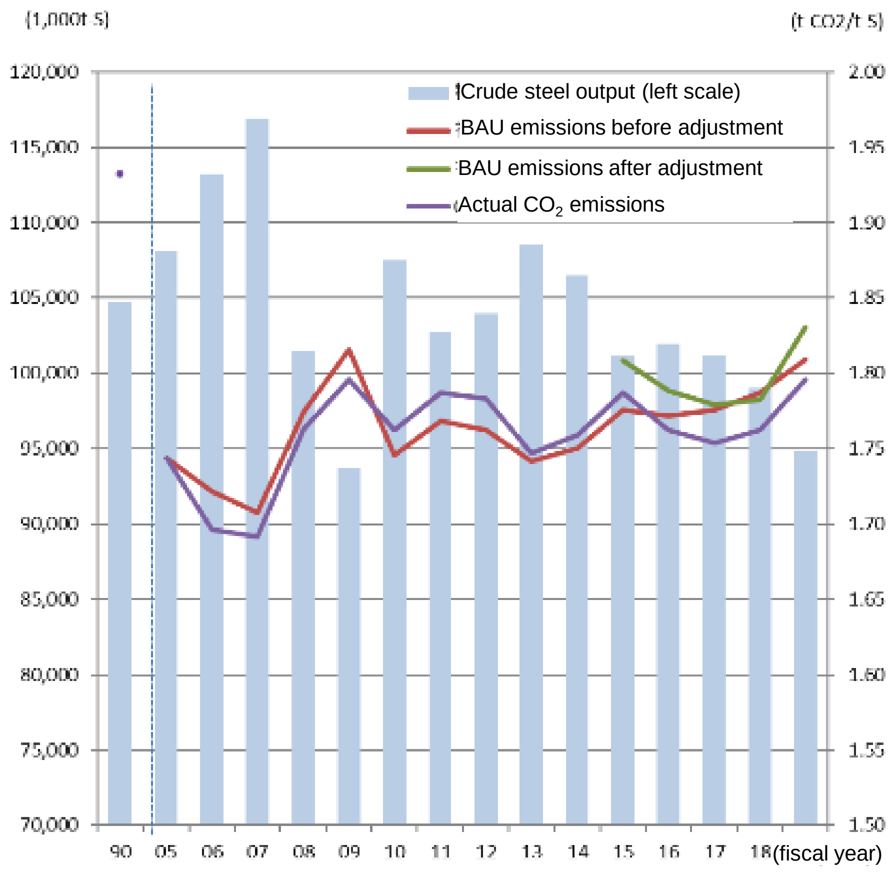
Source: RITE "Estimated Energy Unit Consumption in 2015"

Crude Steel Output and Total and Unit CO_2 Emissions

Crude Steel Output and CO_2 Emissions (constant FY2005 electric power emission coefficient)



Crude Steel Output and Unit CO_2 Emissions (constant FY2005 electric power emission coefficient)



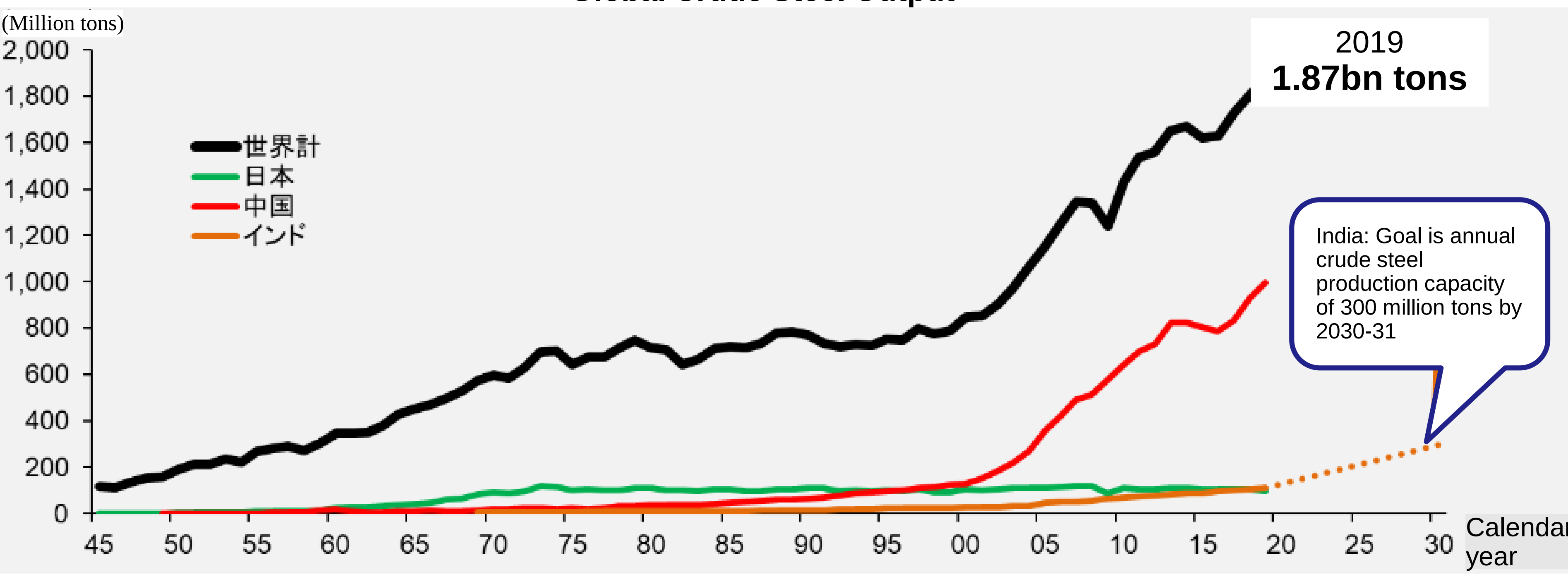
Eco Solution: Growth of Global Crude Steel Output

- As of the end of 2015, the per capita steel stock in Japan was 10.7 tons compared with 4.0 tons worldwide.
- Steel stock per capita is an indicator of the penetration of social infrastructure and industrial products, which are a measure of prosperity. The steel stock is expected to grow steadily in emerging countries as these countries become more prosperous and accomplish Sustainable Development Goals (SDGs).

Global crude steel output will increase for many more years

India's steel industry plans to approximately triple crude steel output to 300 million tons by 2030.

Global Crude Steel Output



Source: worldsteel

The Japanese Steel Industry's Overseas Contributions to Energy Conservation

1. China: Japan-China Steel Industry Environmental Protection and Energy Conservation Technology Conference (2005~)

- This conference has been held periodically since steel industry leaders of the two countries signed an MoU in July 2005. Providing a forum for exchanges of information about steel technologies, this conference plays a key role in international steel industry cooperation.
- The 11th conference was held in Taiyuan, China's Shanxi Province, in October 2019. It has been over 10 years since the first conference was held. It has been confirmed that Chinese mills have advanced greatly in terms of environmental protection and energy conservation measures, and this event has helped Chinese mills undertake relevant measures（(In 2020, this Conference was postponed due to the COVID-19.）.

2. India: Public and Private Collaborative Meeting between the Indian and Japanese Steel industries (2011~)

- Started in 2011, this meeting has been held eight times, bringing together public and private-sector energy conservation experts in the two countries.
- The Japanese steel industry has provided assistance concerning the introduction of its energy conservation technologies in India. Activities include steel plant diagnosis using ISO14404, the establishment of a Technologies Customized List containing energy conservation technologies suitable for India, and technology seminars held by Japanese manufacturers of energy conservation equipment.

3. ASEAN: ASEAN-Japan Steel Initiative (2014~)

- Started in February 2014, this initiative brings together steel industry energy conservation professionals from Japan and six ASEAN countries. Since the start of this initiative, workshops for specific themes have been held for the ASEAN region and individual countries to support energy conservation measures in the ASEAN steel industry.
- There have been steel plant diagnoses at 14 ASEAN steel mills in order to provide advice for improving operations and using new technologies.

Technologies Customized List

The Technologies Customized List contains information about technologies involving energy conservation and protecting the environment that are recommended for specific countries and regions. These lists have been prepared for India and the ASEAN region.

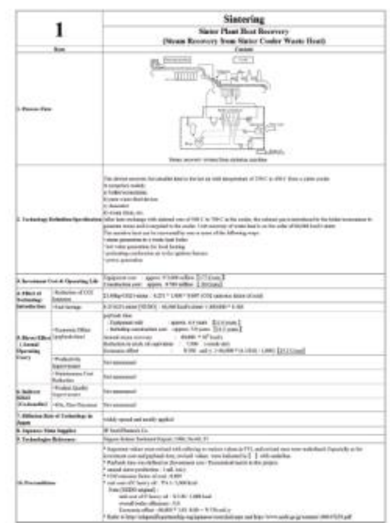
The Technologies Customized List for India

35 recommended technologies
(33 techs for Bf-BOF and 34 techs for EAF)

Energy conservation benefits, technology suppliers and other information

Technology Explanation Sheets

Thorough explanations of individual technologies



JISF's website：http://www.jisf.or.jp/en/activity/climate/Technologies/index.html

Contribution to the introduction of energy-saving technologies in the Indian steel industry

At nine steelworks where steel plant diagnoses were implemented between 2007 and 2018, Japanese experts recommended the introduction of energy conservation technologies in **42 cases** on the basis of the Technologies Customized List. **About 70%** of the recommended technologies have been introduced or are planned to be introduced (as of January 2021).

India Technologies Customized List
(for blast furnaces)

Technologies recommended for steelworks where energy conservation diagnoses have been implemented and technologies that have been introduced

	Number of cases
Number of technologies recommended	**42**
Number of technologies introduced*	15 (36%)
Number of technologies planned to be introduced	14 (33%)

*Many of them are large-scale, cost-effective technologies, including coke dry quenching (CDQ) and top-pressure recovery turbines (TRT).

Steel Plant Diagnosis

Objective

1. **Evaluate energy efficiency level of the steel plant using ISO14404*.**
2. **Recommend energy saving technologies from Technologies Customized List (TCL) based on the equipment diagnosis to encourage technology transfer from Japan**

***ISO14404 is an international standard for calculating CO2 emissions from a steel plant .**

The steel plant diagnoses have been performed at 26 locations.

- ✓ 12 plants in India
- ✓ 14 plants in the ASEAN region in 6 countries*

*Indonesia, Singapore, Thailand, Philippines, Vietnam, Malaysia

Day1~3

1. **Operation observation of BF-BOF, EAF, reheating furnace and other facilities**
2. **Energy data collection by using ISO14404**

Day4

3. **Reporting session**

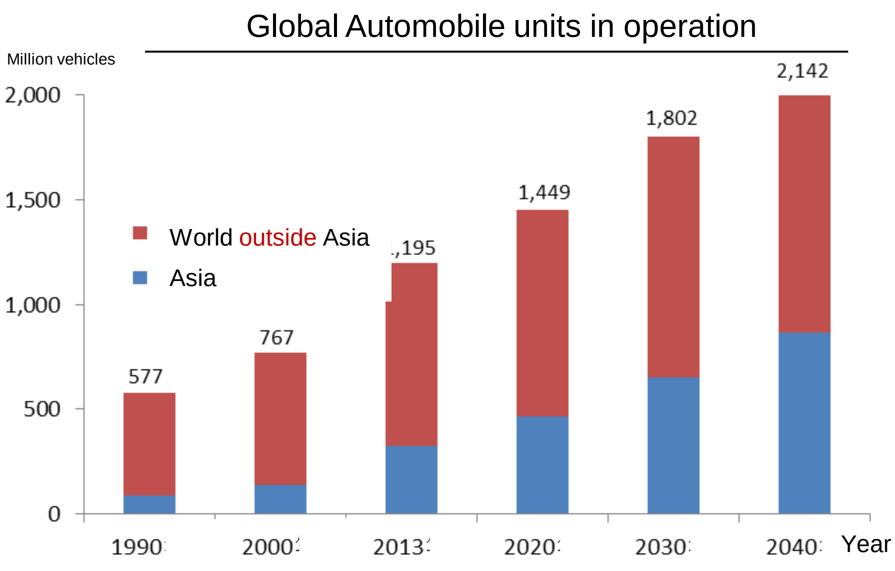
Based on ISO14404, Japanese experts

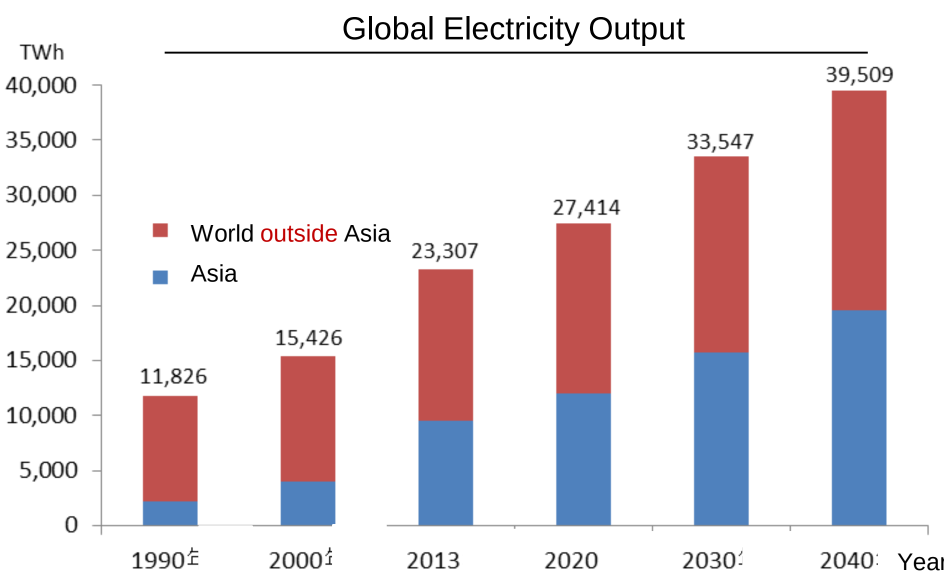
1. *analyze energy consumption trend*
2. *recommend suitable energy saving technologies mainly from TCL*
3. *provide advice for operational improvement*

The Importance of Increasing the Use of Eco Product

- High-performance steel generally has higher CO_2 emissions than ordinary steel does during the manufacturing stage. But high-performance steel is an eco product because it greatly lowers CO_2 emissions when used by making finished products more energy efficient.
- By supplying high-performance steel, the Japanese steel industry is making a big contribution to energy conservation and cutting CO_2 emissions in Japan and around the world. Furthermore, this steel supports “green” economic growth in Japan and creates jobs as the steel is exported to users worldwide.
- Global demand for electricity and motor vehicles is certain to increase as economic growth continues, chiefly in emerging countries. Demand for high-performance steel is expected to become even greater as a result. Meeting the need for high-performance steel will therefore be critical from the standpoints of supporting Japan’s economic growth and protecting the global environment.

Asia/Global Energy Outlook 2015 by The Institute of Energy Economics, Japan





Source: The Institute of Energy Economics, Japan

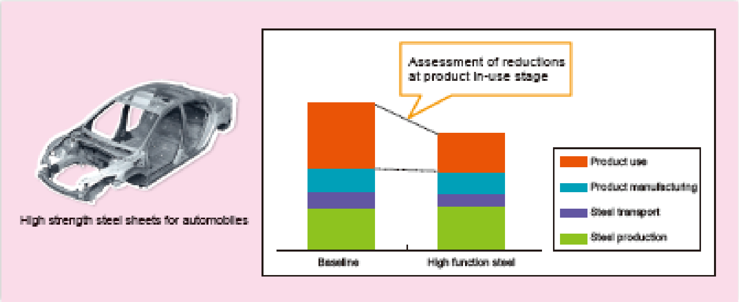
Eco Product Contribution:Quantitative Evaluation of Contribution of High Strength Sheets for Automobiles

High Strength Sheets for Automobiles — The Japan Iron and Steel Federation

Raw materials/materials > Manufacturing > Sales/Distribution > Use > Disposal/recycling

Summary

Emissions can be effectively reduced at the in-use stage by using high-function steels in components of final products. High strength steel sheets for automobiles are steel sheets that can be thinned out while maintaining high strength (and thus reducing steel product weight). Automobiles using this material are lighter than those using conventional steel sheets without such features, thus leading to fuel efficiency improvements that enable CO_2 emission reductions during operation.



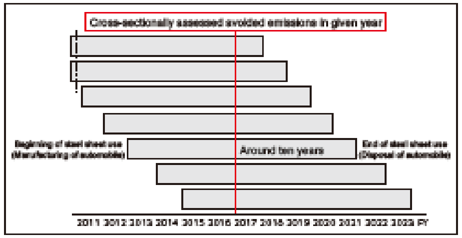
Quantification results of avoided emissions

Avoided emissions at the in-use stage of high-strength steel sheets for automobiles in FY2017 were as provided below:

Domestic use 4.5 million t-CO_2
Exports 8.49 million t-CO_2
Total 12.99 million t-CO_2

Avoided emissions were calculated using the formula provided below. A cross-sectional assessment was conducted for total stock in a given year to estimate avoided emissions.
Avoided emissions = Number of new cars manufactured × Average travel distance × Fuel efficiency improvement rate / Average fuel efficiency of new cars × Average years in use

Image of calculations of avoided emissions (High strength sheets for automobiles)



ario and assumptions

①Baseline scenario

The case study assessed CO_2 emission reductions from improving fuel efficiency at the in-use stage of automobiles by replacing steel sheets without special functions (normal steel), which serve as the baseline, with high strength steel sheets up to the current share.

	Baseline	Assessed steel sheets	Assessed results
Automobiles	Normal steel	High strength steel sheets (YP340)	Energy savings due to reducing steel sheet weight

②Assumptions

High strength steel sheets can be made thinner than baseline normal steel while maintaining high strength; and therefore, automobiles using this material are lighter than those using conventional steel sheets without such properties, thus leading to fuel efficiency improvements that enable CO_2 emission reductions during operation. (Quantifications are estimates based on actual data.)

(2) Scope of quantification

①Target steel sheets

Steel sheets used domestically and exported steel. (Steel exports from 2009)
The case study covered only steel manufactured in Japan, and excluded overseas manufacture.
(Japanese steel manufacturers do not possess integrated steelworks overseas.)

②Target stages

The case study assessed CO_2 emission reductions due to fuel efficiency improvements at the in-use stage of automobiles.
As raw material mining and transport account for a minuscule percentage of the entire life cycle of iron and steel, and also because the assessment involves replacing steel products, little change is seen at the manufacturing stage.
When assessing the effect of reducing the weight of steel, CO_2 emissions from raw material mining and transport become less than the baseline in accordance with the reduced amount of steel used, but the Federation includes only the in-use stage in its quantifications.

(3) Assessment period

From the viewpoint of comparing CO_2 emissions from a manufacturing process during one fiscal year, the case study performed a cross-sectional assessment of stock.

(4) References

Papers on the method of analysis have been published on the Institute of Energy Economics, Japan website:

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives: Overview (Japanese) https://eneken.ieej.or.jp/data/pdf/462.pdf
Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives: Study 3. Automobiles (high strength steel sheets) (Japanese) https://eneken.ieej.or.jp/data/pdf/465.pdf
Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives (English) https://eneken.ieej.or.jp/data/en/data/pdf/165.pdf
Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives (English) https://eneken.ieej.or.jp/en/data/pdf/172.pdf

Source：Japan Business Federation, "*Contributing to Avoided Emissions through the Global Value Chain*"

Eco Product Contribution: Quantitative Evaluation of Contribution of High Tensile Strength Plates for Vessels

High Tensile Plates for Vessels

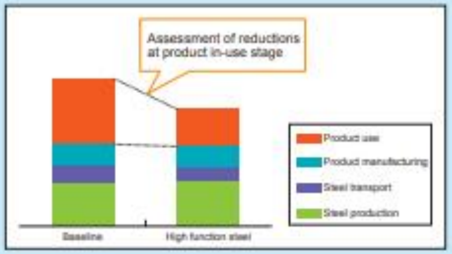
The Japan Iron and Steel Federation

Raw materials/materials > Manufacturing > Sales/Distribution > Use > Disposal/recycling

Summary

Emissions can be effectively reduced at the in-use stage by using high-function steels in components of final products. High tensile plates for vessels are steel plates that can be thinned out while maintaining high strength (and thus reducing steel product weight). Vessels using this material are lighter than those using conventional steel sheets without such features, thus leading to fuel efficiency improvements that enable CO_2 emission reductions during operation.

High tensile plates for vessels



Quantification results of avoided emissions

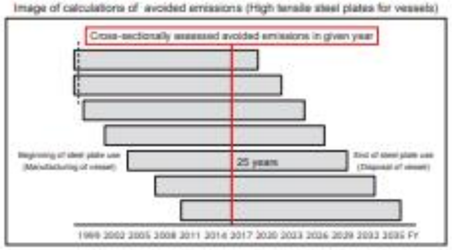
Avoided emissions at the in-use stage of high tensile plates for vessels in FY2017 were as provided below:

Domestic use 1.94 million t-CO_2
Exports 0.61 million t-CO_2
Total 2.55 million t-CO_2

Avoided emissions were calculated using the formula provided below. A cross-sectional assessment was conducted for total stock in a given year to estimate avoided emissions.

Avoided emissions = Fuel consumed by vessels / (1-Weight reduction rate of operating vessels × Contribution ratio to fuel savings) × (Weight reduction rate of operating vessels × Rate of contribution to fuel savings) × Calorific value of fuels

Image of calculations of avoided emissions (High tensile steel plates for vessels)



(1) Baseline scenario and assumptions

① Baseline scenario

The case study assessed CO_2 emission reductions from improving fuel efficiency at the in-use stage of vessels by replacing steel plates without special functions (normal steel), which serve as the baseline, with high tensile steel plates up to the current share.

	Baseline	Assessed steel sheets	Assessed results
Vessels	Normal steel	High tensile steel plates (YP315/YP355)	Energy savings due to reducing steel plate weight

② Assumptions

High tensile plates can be made thinner than baseline normal steel while maintaining high strength; and therefore, vessels using this material are lighter than those using conventional steel sheets without such properties, thus leading to fuel efficiency improvements that enable CO_2 emission reductions during operation. (Quantifications are estimates based on actual data.)

(2) Scope of quantification

① Target steel plates

Steel plates used domestically and exported steel. (Steel exports from 2009)
The case study covered only steel manufactured in Japan, and excluded overseas manufacture.
(Japanese steel manufacturers do not possess integrated steelworks overseas.)

② Target stages

The case study assessed CO_2 emission reductions due to fuel efficiency improvements at the in-use stage of vessels. As raw material mining and transport account for a minuscule percentage of the entire life cycle of iron and steel, and also because the assessment involves replacing steel products, little change is seen at the manufacturing stage. When assessing the effect of reducing the weight of steel, CO_2 emissions from raw material mining and transport become less than the baseline in accordance with the reduced amount of steel used, but the Federation includes only the in-use stage in its quantifications.

(3) Assessment period

From the viewpoint of comparing CO_2 emissions from a manufacturing process during one fiscal year, the case study performed a cross-sectional assessment of stock.

(4) References

Papers on the method of analysis have been published on the Institute of Energy Economics, Japan website:

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives: Overview (Japanese) https://eneken.ieej.or.jp/data/pdf/462.pdf

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives: Study 4. Vessels (high tensile steel plates) (Japanese) https://eneken.ieej.or.jp/data/pdf/466.pdf

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives (1) (English) https://eneken.ieej.or.jp/data/en/data/pdf/165.pdf

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives (2) (English) https://eneken.ieej.or.jp/en/data/pdf/172.pdf

Source：Japan Business Federation, "*Contributing to Avoided Emissions through the Global Value Chain*"

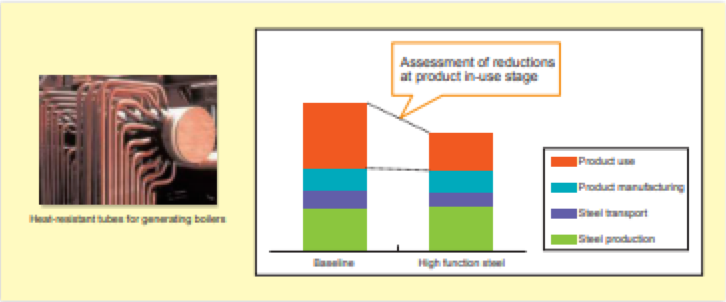
Eco Product Contribution: Quantitative Evaluation of Contribution of High Strength, Heat-resistant Tubes for Boilers

Generating Boiler (Heat-resistant Tubes) | **The Japan Iron and Steel Federation**

Raw materials/materials > Manufacturing > Sales/Distribution > Use > Disposal/recycling

Summary

Emissions can be effectively reduced at the in-use stage by using high-function steels in components of final products. Heat-resistant high strength steel tubes for generating boilers can resist higher temperatures than conventional heat-resistant steel tubes, and can thus improve the power generation efficiency of steam power plants. This leads to CO_2 emission reductions from fuel consumption savings.



Quantification results of avoided emissions

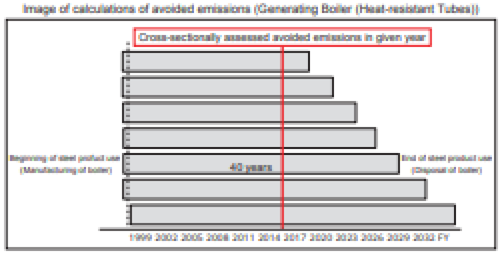
Avoided emissions at the in-use stage of heat-resistant tubes for generating boilers in FY2017 were as provided below:

Domestic use	0.96 million t-CO_2
Exports	4.30 million t-CO_2
Total	5.26 million t-CO_2

Avoided emissions were calculated using the formula provided below. A cross-sectional assessment was conducted for total stock in a given year to estimate avoided emissions.

Avoided emissions = Fuel savings due to efficiency improvements achieved at 593°C – 600°C-class steam power plants as a result of shifting from 566°C-class steam power plants × Rate of contribution of high-performance heat-resistant tubes, or 25% × Number of years power plants are in service

Image of calculations of avoided emissions (Generating Boiler (Heat-resistant Tubes))



(1) Baseline scenario and assumptions

① Baseline scenario

The case study assessed CO_2 emission reductions attributable to savings in fuel input due to replacing baseline heat-resistant tubes for supercritical (SC) 566°C-class steam power plants with high alloy steel boiler tubes for ultra-supercritical (USC) 593°C– 600°C-class steam power plants.

	Baseline	Assessed steel sheets	Assessed results
Heat-resistant high strength tubes for boilers	Steel tubes for supercritical (SC) 566°C-class steam power plants	High alloy steel tubes (improved steel allow 9Cr-5Mo/heat-resistant tube)	Energy savings due to enhanced heat-resistance and strength (higher steam temperatures = higher power generation efficiency)

② Assumptions

High alloy steel tubes can resist higher temperatures compared to the baseline steel tubes for supercritical (SC) 566°C-class steam power plants. Therefore, steam power plants equipped with high alloy steel tubes can operate under higher ranges of steam temperature compared with those using steel boiler tubes for supercritical (SC) 566°C-class steam power plants, thus improve power generation efficiency which will result in energy savings. (Quantifications are estimates based on actual data.)

(2) Scope of quantification

① Target steel tubes

Steel tubes used domestically and exported steel. (Steel exports from 2009)

The case study covered only steel manufactured in Japan, and excluded overseas manufacture.

(Japanese steel manufacturers do not possess integrated steelworks overseas.)

② Target stages

The case study assessed CO_2 emission reductions due to improved fuel consumption at the in-use stage of boilers. As raw material mining and transport account for a minuscule percentage of the entire life cycle of iron and steel, and little change is seen at the manufacturing stage because the assessment involves replacing steel products, the Federation includes only the in-use stage in its quantifications.

(3) Assessment period

From the viewpoint of comparing CO_2 emissions from a manufacturing process during one fiscal year, the case study performed a cross-sectional assessment of stock.

(4) References

Papers on the method of analysis have been published on the Institute of Energy Economics, Japan website:

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives: Overview (Japanese) https://eneken.ieej.or.jp/data/pdf/462.pdf

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives: Study 2. Generating boilers (heat-resistant tubes) (Japanese) https://eneken.ieej.or.jp/data/pdf/464.pdf

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives (1) (English) https://eneken.ieej.or.jp/data/en/data/pdf/165.pdf

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives (2) (English) https://eneken.ieej.or.jp/en/data/pdf/172.pdf

Source：Japan Business Federation, "*Contributing to Avoided Emissions through the Global Value Chain*"

Eco Product Contribution: Quantitative Evaluation of Contribution of Grain-oriented Sheets for Transformers

Grain-oriented Silicon Steel Sheets for Transformers

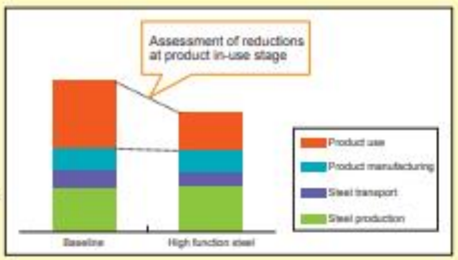
The Japan Iron and Steel Federation

Raw materials/materials > Manufacturing > Sales/Distribution > Use > Disposal/recycling

Summary

Emissions can be effectively reduced at the in-use stage by using high-function steels in components of final products. Current grain-oriented silicon steel sheets for transformers can reduce iron loss (energy loss) during transformation; and therefore contribute to efficient electric power transmission, and thus CO_2 emission.

Grain-oriented silicon steel sheets for transformers



Quantification results of avoided emissions

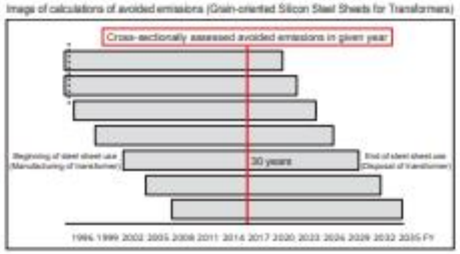
Avoided emissions at the in-use stage of grain-oriented silicon steel sheets for transformers in FY2017 were as provided below:

Domestic use	2.15 million t-CO_2
Exports	6.51 million t-CO_2
Total	8.66 million t-CO_2

Avoided emissions were calculated using the formula provided below. A cross-sectional assessment was conducted for total stock in a given year to estimate avoided emissions.

Avoided emissions = minimum value*
× (Transformer no-load losses per unit capacity in an assessment year - Transformer no-load losses per capacity 30 years ago)
× Hours of use

Image of calculations of avoided emissions (Grain-oriented Silicon Steel Sheets for Transformers)



*Comparing the amount of transformers produced in the assessment year and that of thirty years ago, if [production in the assessment year] < [production 30 years ago], then was assumed that all transformers produced thirty years ago have been replaced and the minimum value is represented by production 30 years ago. In contrast, if [production 30 years ago] < [production in the assessment year], then it was assumed that transformers produced thirty years ago have not been completely replaced but have only been replaced by those produced in the assessment year; and therefore, the minimum value is represented by production in the assessment year.

(1) Baseline scenario and assumptions

① Baseline scenario

The case study assumed that transformers have a durable life of 30 years, and assessed CO_2 emission reductions attributable to iron loss due to replacing silicon steel sheets for transformers from 30 years ago, which serve as the baseline, with current silicon steel sheets for transformers.

	Baseline	Assessed steel sheets	Assessed results
Transformers	Silicon steel sheets for transformers 30 years ago	Current silicon steel sheets for transformers	Energy savings due to reducing iron loss

② Assumptions

Current silicon steel sheets for transformers can reduce iron loss (energy loss) compared conventional silicon steel sheets for transformers (from thirty years ago), and can thus contribute to efficient electric power transmission and distribution as well as achieving CO_2 emission reductions during operation as a result of improving electric power consumption accompanying iron loss. (Quantifications are estimates based on actual data.)

(2) Scope of quantification

① Target steel sheets

Steel sheets used domestically and exported steel. (Steel exports from 2009)

The case study covered only steel manufactured in Japan, and excluded overseas manufacture.

(Japanese steel manufacturers do not possess integrated steelworks overseas.)

② Target stages

The case study assessed CO_2 emission reductions due to iron loss reductions at the in-use stage of transformers. As raw material mining and transport account for a minuscule percentage of the entire life cycle of iron and steel, and little change is seen at the manufacturing stage because the assessment involves replacing steel products, the Federation includes only the in-use stage in its quantifications.

(3) Assessment period

From the viewpoint of comparing CO_2 emissions from a manufacturing process during one fiscal year, the case study performed a cross-sectional assessment of stock.

(4) References

Papers on the method of analysis have been published on the Institute of Energy Economics, Japan website:

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives: Overview (Japanese) https://eneken.ieej.or.jp/data/pdf/462.pdf

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives: Study 5 Grain-oriented silicon steel sheets for transformers (Japanese) https://eneken.ieej.or.jp/data/pdf/467.pdf

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives (1) (English) https://eneken.ieej.or.jp/data/en/data/pdf/165.pdf

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives (2) (English) https://eneken.ieej.or.jp/en/data/pdf/172.pdf

Source：Japan Business Federation, “*Contributing to Avoided Emissions through the Global Value Chain*”

Eco Product Contribution: Quantitative Evaluation of Contribution of Stainless Steel Sheets for Railway Cars

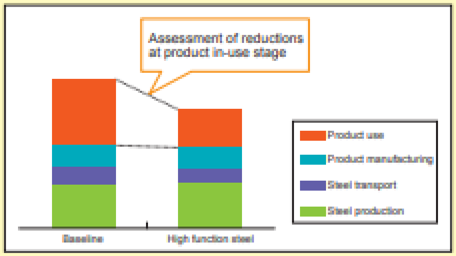
Stainless Steel Sheets for Railway Cars — The Japan Iron and Steel Federation

Raw materials/materials > Manufacturing > Sales/Distribution > Use > Disposal/recycling

Summary

Emissions can be effectively reduced at the in-use stage by using high-function steels in components of final products. Stainless steel sheets from railway cars are steel plates that can be thinned out while maintaining high strength (and thus reducing steel product weight). Railway cars using this material are lighter than those using conventional steel sheets without such features, thus leading to fuel efficiency improvements that enable CO_2 emission reductions during operation.

Stainless steel sheets for railway cars



Quantification results of avoided emissions

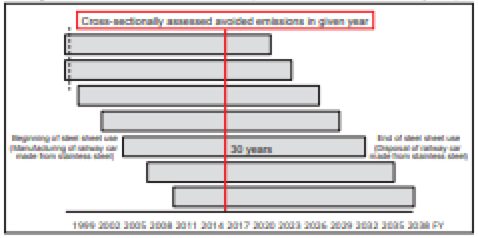
Avoided emissions at the in-use stage of stainless steel sheets for railway cars in FY2017 were as provided below:

Domestic use	0.27 million t-CO_2
Exports	0 t-CO_2
Total	0.27 million t-CO_2

Avoided emissions were calculated using the formula provided below. A cross-sectional assessment was conducted for total stock in a given year to estimate avoided emissions.

Avoided emissions = Energy saved during operation per unit railway car weight reduced per unit distance travelled per car × Weight reduced per car × Annual distance travelled per car × Number of stainless steel railway cars produced annually

Image of calculations of avoided emissions (Stainless steel sheets for railway cars)



(1) Baseline scenario and assumptions

① Baseline scenario

The case study assessed CO_2 emission reductions from improving fuel efficiency at the in-use stage of railway cars by replacing steel sheets without special functions (normal steel), which serve as the baseline, with stainless steel sheets up to the current share.

	Baseline	Assessed steel sheets	Assessed results
Railway cars	Normal steel	Stainless steel sheets	Energy savings due to reducing steel sheet weight

② Assumptions

High strength sheets can be made thinner than baseline normal steel while maintaining high strength; and therefore, railway cars using this material are lighter than those using conventional steel sheets without such properties, thus leading to fuel efficiency improvements that enable CO_2 emission reductions during operation. (Quantifications are estimates based on actual data.)

(2) Scope of quantification

① Target steel sheets

Steel sheets used domestically and exported steel. (Steel exports from 2009)

The case study covered only steel manufactured in Japan, and excluded overseas manufacture.

(Japanese steel manufacturers do not possess integrated steelworks overseas.)

② Target stages

The case study assessed CO_2 emission reductions due to fuel efficiency improvements at the in-use stage of railway cars.

As raw material mining and transport account for a minuscule percentage of the entire life cycle of iron and steel, and also because the assessment involves replacing steel products, little change is seen at the manufacturing stage. When assessing the effect of reducing the weight of steel, CO_2 emissions from raw material mining and transport become less than the baseline in accordance with the reduced amount of steel used, but the Federation includes only the in-use stage in its quantifications.

(3) Assessment period

From the viewpoint of comparing CO_2 emissions from a manufacturing process during one fiscal year, the case study performed a cross-sectional assessment of stock.

(4) References

Papers on the method of analysis have been published on the Institute of Energy Economics, Japan website:

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives: Overview (Japanese) https://eneken.ieej.or.jp/data/pdf/462.pdf

Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives: Study 6. Railway cars (stainless steel sheets) (Japanese) https://eneken.ieej.or.jp/data/pdf/468.pdf

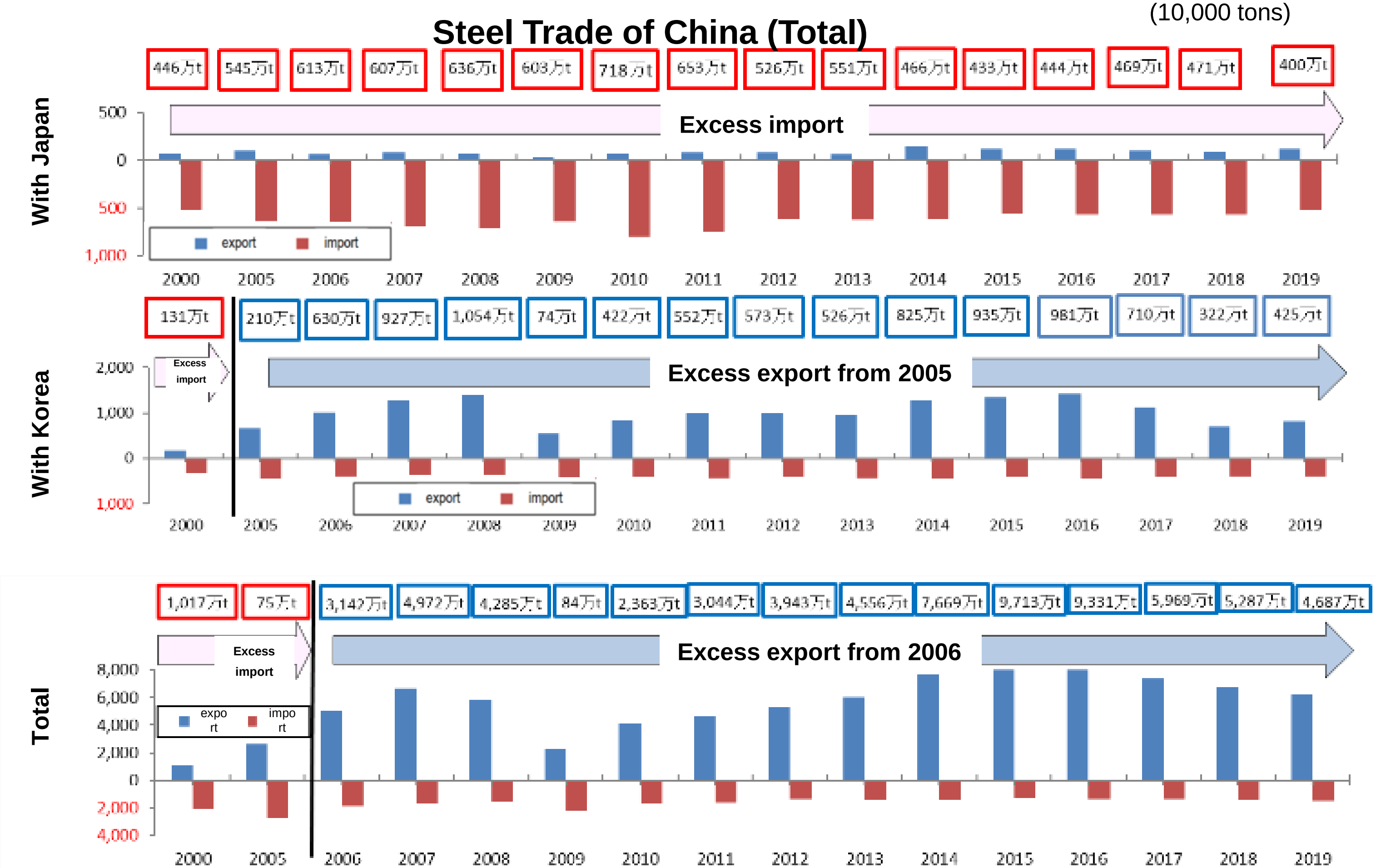
Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives (1) (English) https://eneken.ieej.or.jp/data/en/data/pdf/165.pdf

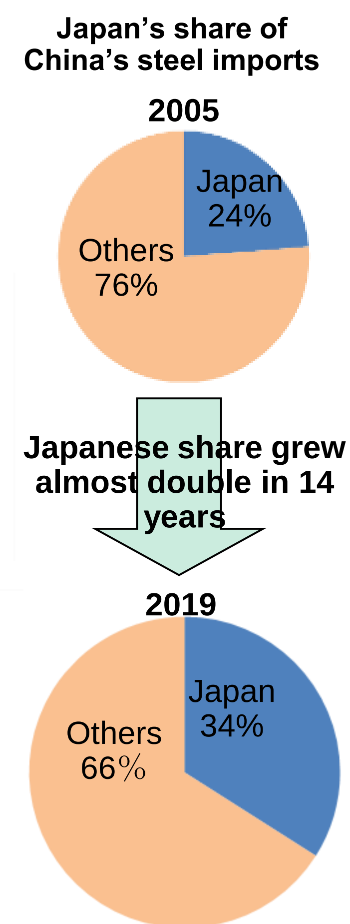
Research on Contribution of Steel Products to Society-wide Energy Conservation from LCA Perspectives (2) (English) https://eneken.ieej.or.jp/en/data/pdf/172.pdf

Source: Japan Business Federation, "*Contributing to Avoided Emissions through the Global Value Chain*"

Eco Product: The global competitive edge of the Japanese steel industry, mainly for high-performance steel

- Steel from other countries is incomparable with Japan's high-performance steel in terms of performance, quality, supply and other attributes. High-performance steel is the core element of the international competitive edge of the Japanese steel industry.
- China, the world's largest steel producer, became a net exporter of steel in 2006. Japan is the only net exporter of steel to China now.





Source: China's customs statistics

CO_2 Emission Reduction from Blast Furnace Slag Used in Cement

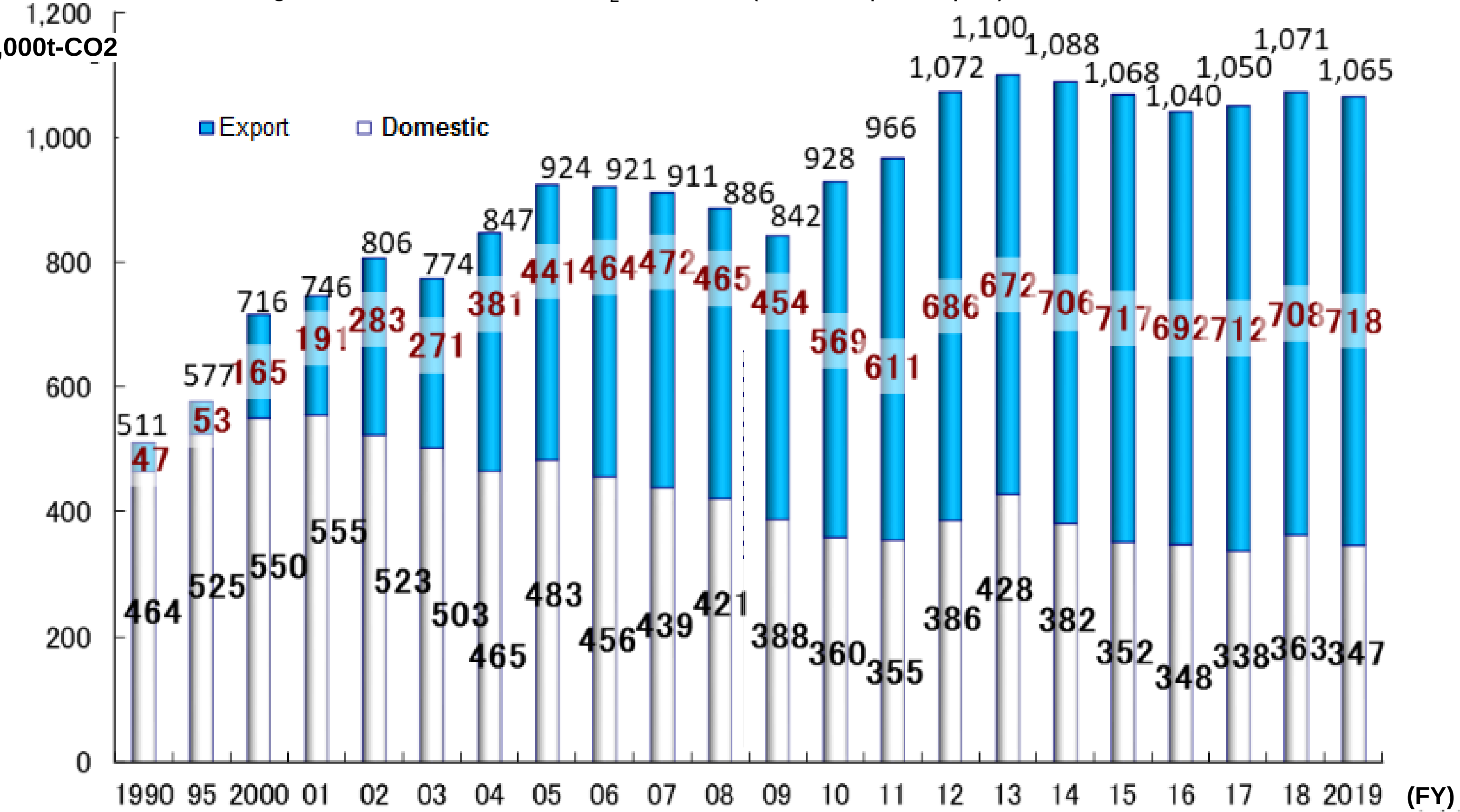
Mixed cement (mainly slag cement) is one way to lower CO_2 emissions related to energy consumption. The use of this cement is growing and a further increase in the production ratio of mixed cement could significantly lower CO_2 emissions.

Replacing conventional cement (Portland cement), which generates CO_2 during the firing of raw materials, with slag cement, which does not generate CO_2 during production, reduced annual CO_2 emissions by 10.65 million tons/year (FY19).

- **Japan: Annual reduction of 3.47 mn tons of CO_2**
- **Exports: Annual reduction of 7.18 mn tons of CO_2**

Assumptions for emission reduction contribution Conversion to volume of cement: 450kg of slag/ Ton of cement CO_2 emission reduction: 312kg of CO_2/Ton of cement

Estimate of contribution of slag cement to reductions in CO_2 emissions (domestic plus export)



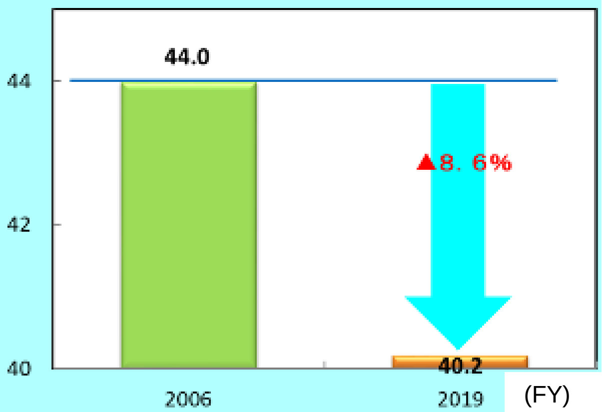
Source: Japan Cement Association, Nippon Slag Association

Initiatives in the cargo transport sector

- CO_2 emissions per unit of cargo transport decreased to 42.0kg of CO_2/k ton-km in FY19 from 44.0kg of CO_2/k ton-km in FY06.
- In FY19, the steel industry modal shift (ships + rail) was 76% for primary transportation and 96% for cargo transported more than 500km. This is far higher than the average modal shift rate of 38.1% for all industries in Japan (Ministry of Land, Infrastructure and Transport FY05 data for more than 500km).
- Steelmakers are taking other actions too, such as improving cargo transport efficiency by using a higher pct. of cargo space on ships, utilizing shore-based electric power supplies for ships and using eco-tires on trucks and using eco-friendly driving methods.

CO_2 Emissions per Unit of Cargo Transport

(kg of CO_2/k tons-km)



*Total CO2 emissions from the use of gasoline and diesel oil, heavy oil, etc. of the 45 companies cooperating in the survey, divided by the number of tons/km transported.

Use of binary power generation systems for ships

[Effects and characteristics]

- Using the exhaust heat from the main engines of ships, which was previously disused, as a heat source for power generation
- The power generated is used effectively as a supplemental power source for the ship. This contributes to reducing fuel used for generator engines and CO_2 emissions.

[Example of use of a binary power generation system]

Kobe Steel and Kawasaki Kisen Kaisha have jointly installed a binary power generation system on a coal ship, and the ship has been in operation since February 2019.

Fuel saving by using electricity from shore-based sources

Cuts fuel oil use by 70% to 90% while ships are docked

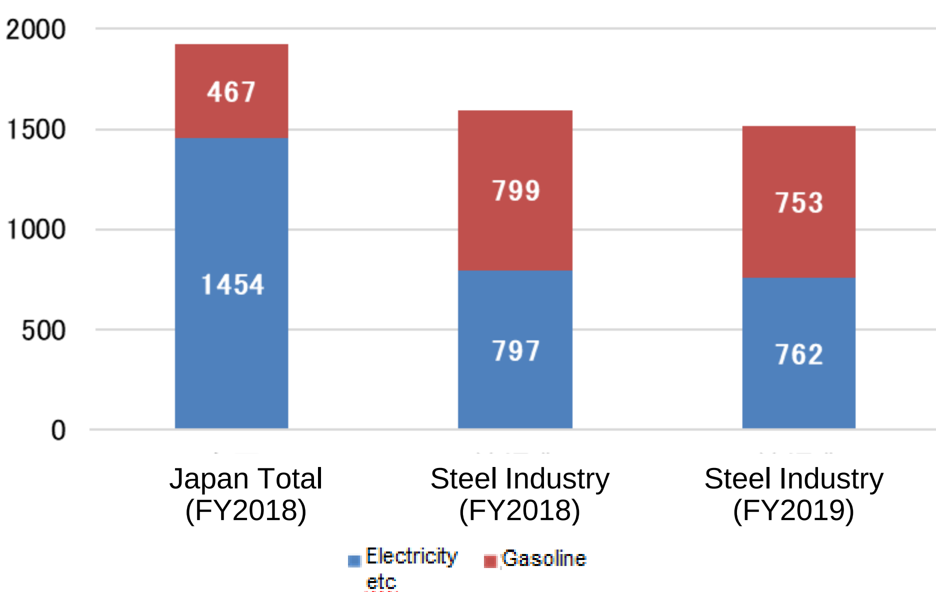
	No. of units
Steel mills	**218**
Junction port	**41**

(Totals for 4 blast furnace and 2 EAF steelmakers as of the end of FY18)

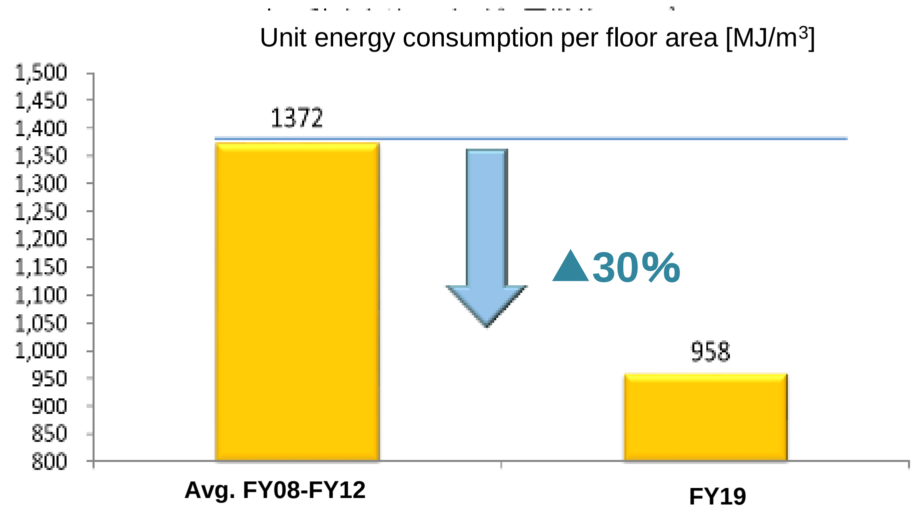
Initiatives in commercial/residential sector

- In FY2005, Japan's steelmakers started energy conservation programs using environmental ledgers for residential sector. Steelmakers started education programs that included all employees, including at group companies, promotion of use of household environmental ledgers, and other actions. There are around 17,000 households participating in this program in FY2019.
- The Japanese Steel industry is taking actions to reduce energy consumption and CO_2 emission from offices. Unit energy consumption in offices in 2019 was down 30% compared to FY 2008-2012.

Household CO_2 Emissions
(CO_2 emissions per individual: kg of CO_2/person-year)



Unit energy consumption in offices



Data for 324 business sites of 67 companies in FY2019

Source: Estimates based on Greenhouse Gas Inventory Office materials
Notes:
1.Total for Japanese households includes households and household use of automobiles.
2. Total for steel industry households is an estimate by JISF based on the inventory in Japan

Example of use of unused energy in nearby locations

Supply of heat to sake companies by a steelmaker in the Kobe area

Equipment to supply heat to sake companies

Features of the heat source system

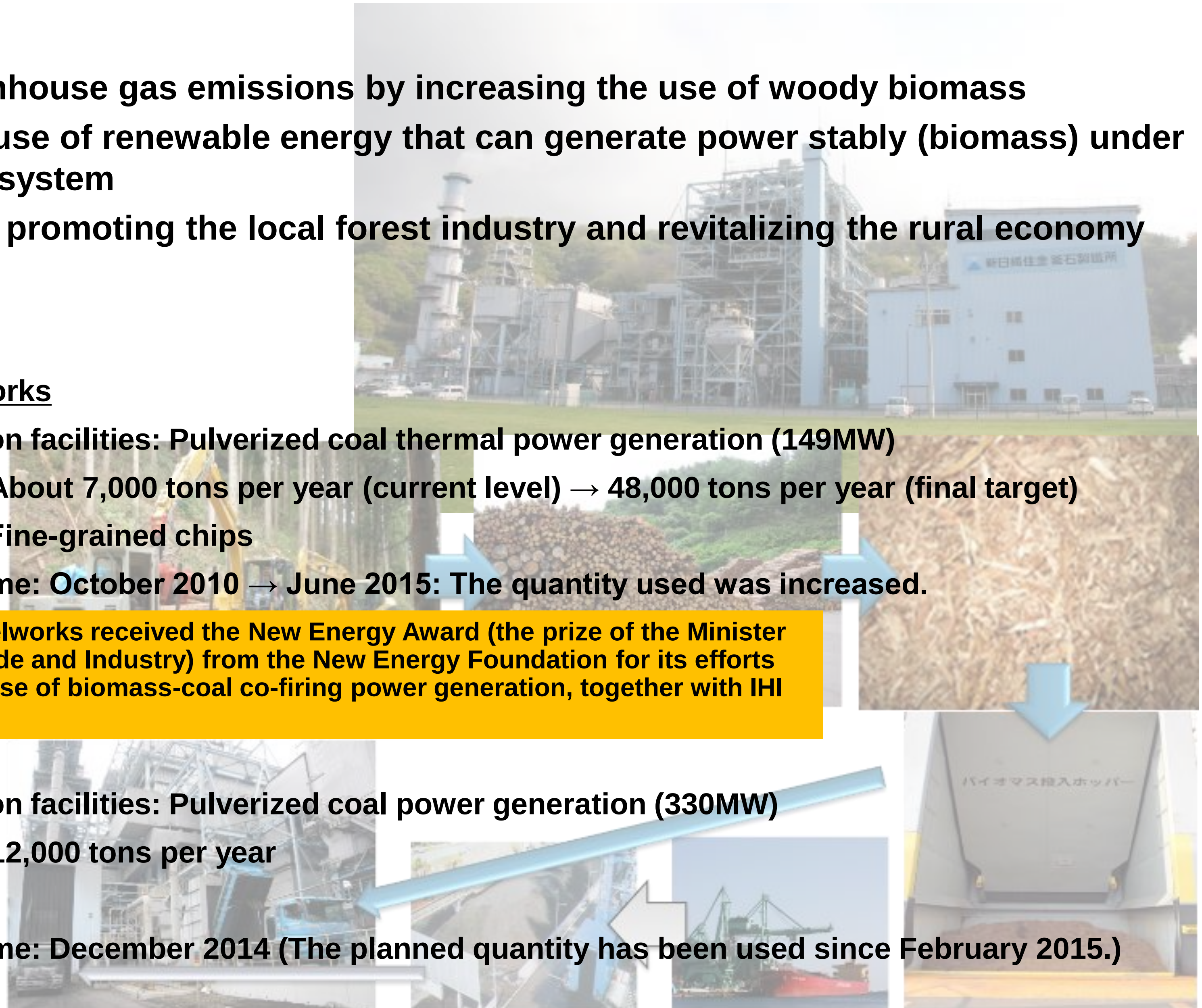
1. **Supply of heat source**
   Steam from a power plant is used as the heat source.
2. **Energy conservation**
   Energy use is down 30% from when each company had its own boiler. Part of steam used for power generation is drawn off from between turbines and supplied in order to reduce energy lost to cooling water.

Equipment

Steam generators	**3**	Steam generation: 40 tons/hour Heating capacity: 29.5GJ Thermal transmission area: 382m2 Primary steam pressure: 1.01MPa (saturation temperature) Secondary steam pressure: 0.837MPa (saturation temperature)
Water softener: 1 set		
Water supply method: Two-pipe system with direct-buried steam (300-150A) and recirculated water (50A) (24-hour supply all year)		

Steam generators

(IPP) Examples of Efforts for Mixed-Firing Power Generation Using Forestry Residue



Characteristics

- Reducing greenhouse gas emissions by increasing the use of woody biomass

- Increasing the use of renewable energy that can generate power stably (biomass) under the feed-in tariff system

- Contributing to promoting the local forest industry and revitalizing the rural economy

Kamaishi Steelworks

Power generation facilities: Pulverized coal thermal power generation (149MW)

Quantity used: About 7,000 tons per year (current level) → 48,000 tons per year (final target)

Type: Chips → Fine-grained chips

Commencing time: October 2010 → June 2015: The quantity used was increased.

In 2017, this steelworks received the New Energy Award (the prize of the Minister of Economy, Trade and Industry) from the New Energy Foundation for its efforts to increase the use of biomass-coal co-firing power generation, together with IHI Corporation.

Oita Steelworks

Power generation facilities: Pulverized coal power generation (330MW)

Quantity used: 12,000 tons per year

Type: Chips

Commencing time: December 2014 (The planned quantity has been used since February 2015.)

Phase 2, Step 1 (FY18-22) Initiatives

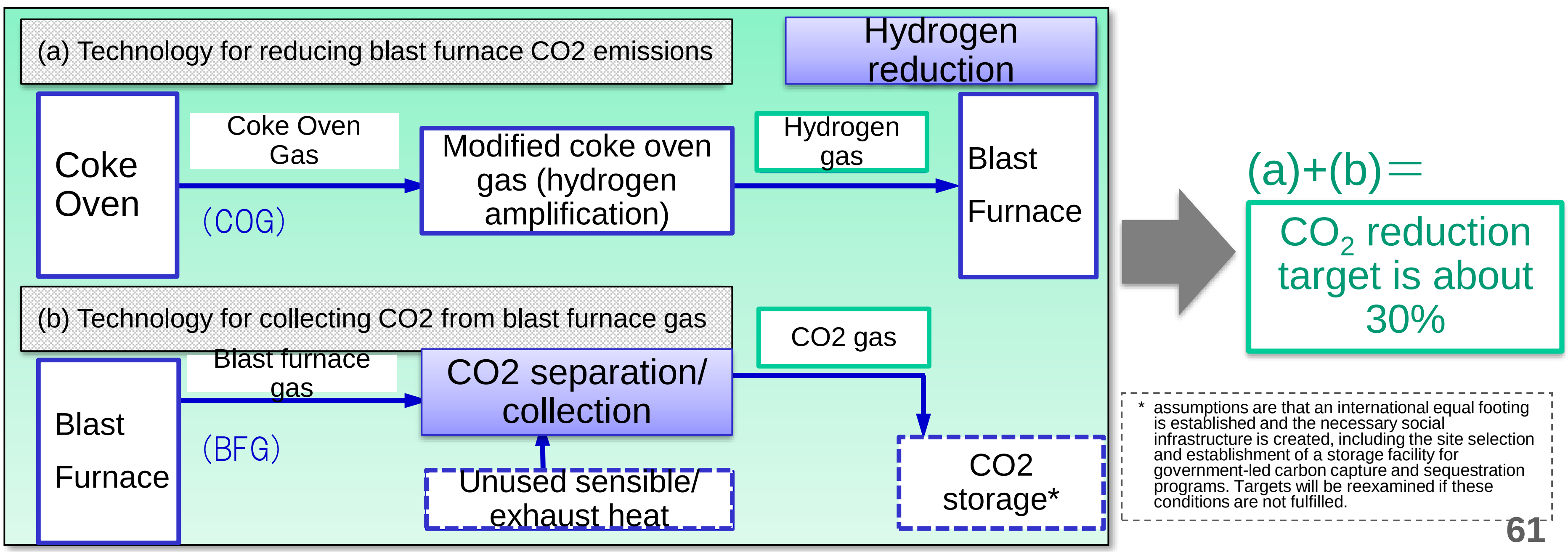
【 (1) Technologies to reduce blast furnace CO_2 emissions】

Prospects for highly feasible technologies for reducing blast furnace CO_2 emissions by about 10% will be acquired. Test operations for “full-circumference tuyere blowing” through partial modification of an actual blast furnace will be carried out after the start of Phase II, Step 2 (in FY 2023) while paying attention to the development of technologies for reducing CO_2 emissions. These test operations are expected to contribute to achieving the above target.

*The test blast furnace will be used continuously until FY 2022, aiming to develop new basic technologies to improve the efficiency of the use of hydrogen and expand hydrogen-reduction steelmaking operations.

【 (2) Technologies to separate and collect CO_2 from blast furnace gas】

Efforts will be made to achieve technologies that make it possible to separate and collect CO_2 at a cost of 2,000 yen per ton of CO_2, hoping to achieve a CO_2 separation and collection energy use of 1.6 GJ per ton of CO_2. These are expected to contribute to developing technologies to reduce CO_2 emissions by about 20%.



Overview of results in FY 2019

(1) Development of technologies to use hydrogen at blast furnaces

- As for development of technologies to reduce blast furnace CO_2 emissions, a main development issue under Phase II, Step1 from FY 2018 to FY 2022 (the first phase of practical development), test facilities that combine a test blast furnace with chemical absorption facilities were used to promote base technology development with a view to scaling up the tests.

(2) Development of technologies to separate and collect CO_2 from blast furnace gas

- As for development of technologies to separate and collect CO_2 from blast furnace gas, studies were conducted to further improve the performance of absorbents, which is already at the top level in the world, aiming to achieve technologies that make it possible to separate and collect CO_2 at a cost of 2,000 yen per ton of CO_2 or lower.

Source: The FY 2019 activity report of the Japan Iron and Steel Federation (JISF)

Test blast furnace

（Nippon Steel, Kimitsu Works）

（Ref）Excerpt of Progressive Environment Innovation Strategy

Ⅲ. 産業

水素　CC

化石資源依存からの脱却（再生可能エネルギー由来の電力や水素の活用）

⑯ 水素還元製鉄技術等による「ゼロカーボン・スチール」の実現

【目標】

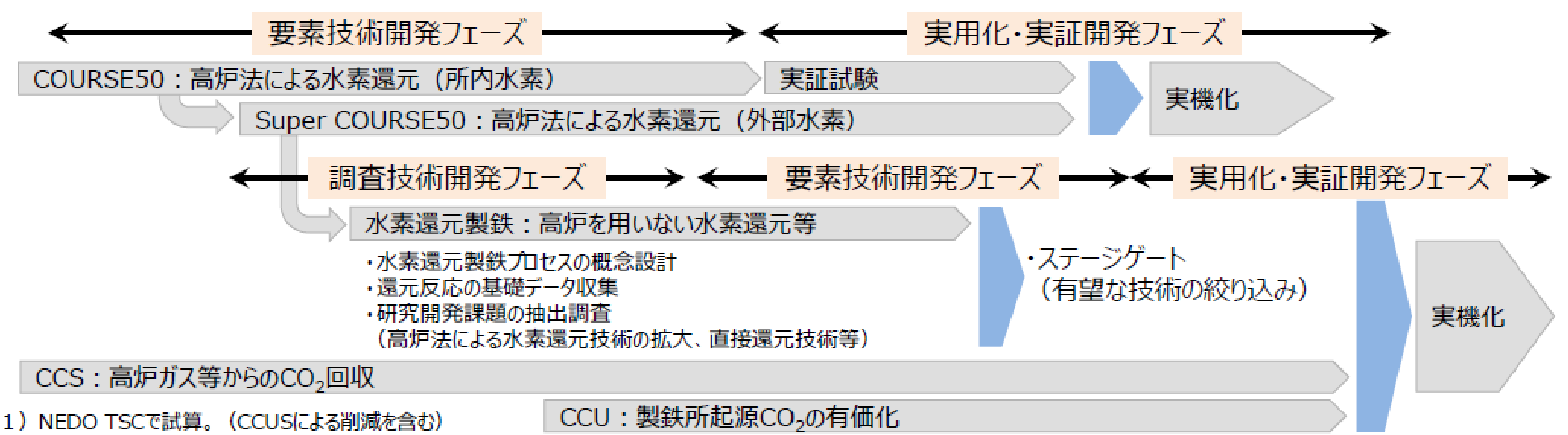
- 2050年以降のできるだけ早い時期までに、現在の高炉法による鉄鋼製造と同等のコストで「ゼロカーボン・スチール」を実現する水素還元製鉄技術等の超革新技術の開発を行う。実用化には、2050年の水素コスト（プラント引渡しコスト）20円/Nm^3という目標をさらに下回る水準でCO_2フリー水素が安定的かつ大量に供給されることが必要。世界のCO_2削減量は約38億トン。[1)]

【技術開発】

- 「ゼロカーボン・スチール」の実現には長期的な研究開発が必要となるため、現行の高炉法における低炭素化、省エネルギー対策も重要となる。そのため、COURSE50やフェロコークス技術の開発を引き続き行い、2030年頃の実用化を目指す。
- COURSE50及びフェロコークスの開発で得られる知見を足掛かりとして、「ゼロカーボン・スチール」の実現に向けた更なる革新技術を検討する。このため更なる革新技術に関するFS事業を実施し、高炉法による水素還元の拡大技術（COURSE50技術の拡大）、直接還元法による水素還元製鉄技術、CCUS等の技術開発や実用化における諸課題の抽出等を行う。当該結果を踏まえ、ナショナルプロジェクトによる支援の下に「ゼロカーボン・スチール」を実現する革新技術開発を進める。

（実施体制）

- 国際的な競争領域であるため、国内鉄鋼メーカーを中心とした連携により技術開発を進める。



1）NEDO TSCで試算。（CCUSによる削減を含む）

Efforts to Achieve Zero-Carbon Steel Production

- Nov, 2018: Release of “long-term vision for climate change mitigation- A challenge towards Zero-carbon STEEL-”
- In June 2020, Nippon Steel, JFE Steel, and Kobe Steel, which are members of the JISF, and the Japan Research and Development Center for Metals (JRCM) were entrusted with a technology development project for realizing zero-carbon steel. The New Energy and Industrial Technology Development Organization (NEDO) had publicly invited applications for the project.
- This project aims to extract several prospective innovative technologies that focus mainly on decarbonization in steel production and to prepare a technology development roadmap for the steel industry of Japan. The JISF has determined to lead the world in undertaking technology development for the purpose of realizing zero-carbon steel by bringing forward initial plans under the above-mentioned long-term vision.

Development of technologies specific to iron & steel sector		2020 2030 2040 2050 2100
COURSE50	Raising ratio of H2 reduction in blast furnace using internal H2 (COG) Capturing CO2 from blast furnace gas for storage	R&D → Implementation
Super COURSE50	Further H2 reduction in blast furnace by adding H2 from outside (assuming massive carbon-free H2 supply becomes available)	R&D → Implementation
H2 reduction iron making	H2 reduction iron making without using coal	R&D → Implementation
CCU	Carbon recycling from byproduct gases	R&D → Implementation
CCS	Recovery of CO2 from byproduct gases.	R&D → Implementation

Development of common fundamental technologies for society		2020 2030 2040 2050 2100
Carbon-free Power	Carbon-free power sources (nuclear, renewables, fossil+CCS) Advanced transmission, power storage, etc.	R&D / Implementation
Carbon-free H2	Technical development of low cost and massive amount of hydrogen production, transfer and storage	R&D → Implementation
CCS/CCU	Technical development on CO2 capture and strage/usage Solving social issues (location, PA, etc.)	R&D → Implementation

Commitment to JISF's Low Carbon Society Phase II

2030←2020

Eco Process

Aiming 9 million-tons CO_2 reduction vs BAU emission in FY2030 by fully implementing state-of-the-art energy technologies

Eco Solution

Contribute worldwide by transferring the world's most advanced energy-saving technologies to other countries (especially to developing countries)and increasing the use of these technologies. (Ca. 50 million tons of CO_2 reduction contribution in FY2013. Ca. 80 million tons of estimated CO_2 emission reduction contribution in FY2030)

Eco Product

By supplying the high-performance steel that is essential to create a low-carbon society, contributes to lowering emissions when finished products using this steel are used.
(Ca. 26 million tons of CO_2 emission reduction contribution in FY2013. Ca. 42 million tons of estimated CO_2 emission reduction contribution in FY2030.)

Development of revolutionary processes (COURSE50)

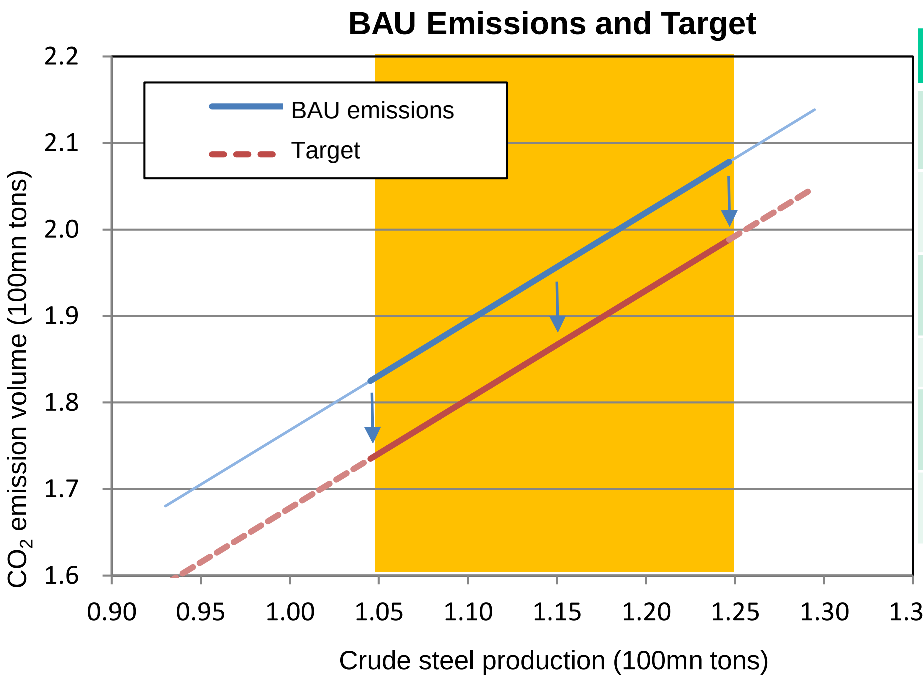
Cut CO_2 emissions from production processes by about 30% by using hydrogen for iron ore reduction and collecting CO_2 from blast furnace gas. The first production unit is to begin operations by about 2030*. The goal is a widespread use of these processes by about 2050 in line with the timing of updates of existing blast furnace facilities.

Development of innovative ironmaking process (Ferro Coke)

Develop ferro-coke that can speed up and lower the temperature of the reduction reaction inside a blast furnace and create the associated operating process. Develop revolutionary technologies that can reduce energy consumption for pig iron production and permit the greater use of low-grade raw materials.

Eco Process (Reduction targets in Japan for production processes)

The 2030 goal for steel production processes is to use advanced technologies as much as possible to lower CO_2 emissions by 9 million tons compared with the volume of these emissions (BAU emission volume) expected from each production volume figure*1 (but excluding the improvement in the electricity coefficient).



Actions	Phase II 2030	Phase I 2020
(1) Improve coke oven efficiency	About 1.3mn tons of CO_2	About 0.9mn tons of CO_2
(2) More efficient electricity generation	About 1.6mn tons of CO_2	About 1.1mn tons of CO_2
(3) More energy conservation	About 1.5mn tons of CO_2	About 1.0mn tons of CO_2
(4) Waste plastics*2	2.0mn tons of CO_2	–
(5) Develop and use revolutionary technologies*3	About 2.6mn tons of CO_2	–
Total	9mn tons of CO_2	3mn tons of CO_2 + Waste plastics*4

These reductions do not include the effect of changes in the electric power emissions coefficient.

FY 2030 Assumption

Crude steel output in Japan (10,000 tons)	Participants' Crude steel output (10,000 tons)	BAU emissions (tons of CO2)	Emissions after target is reached (tons of CO2)
12,000	11,508	19,733	18,833

*1 These targets are based on total crude steel production of 120 million tons in Japan, plus or minus 10 million tons. Emission reductions may be more or less than the anticipated range if there is a significant change in production volume. If there is a significant change, the suitability of the BAU figure and emission reduction will be reexamined in accordance with the actual production level.

*2 Points concerning increasing the use of waste plastics and other waste materials

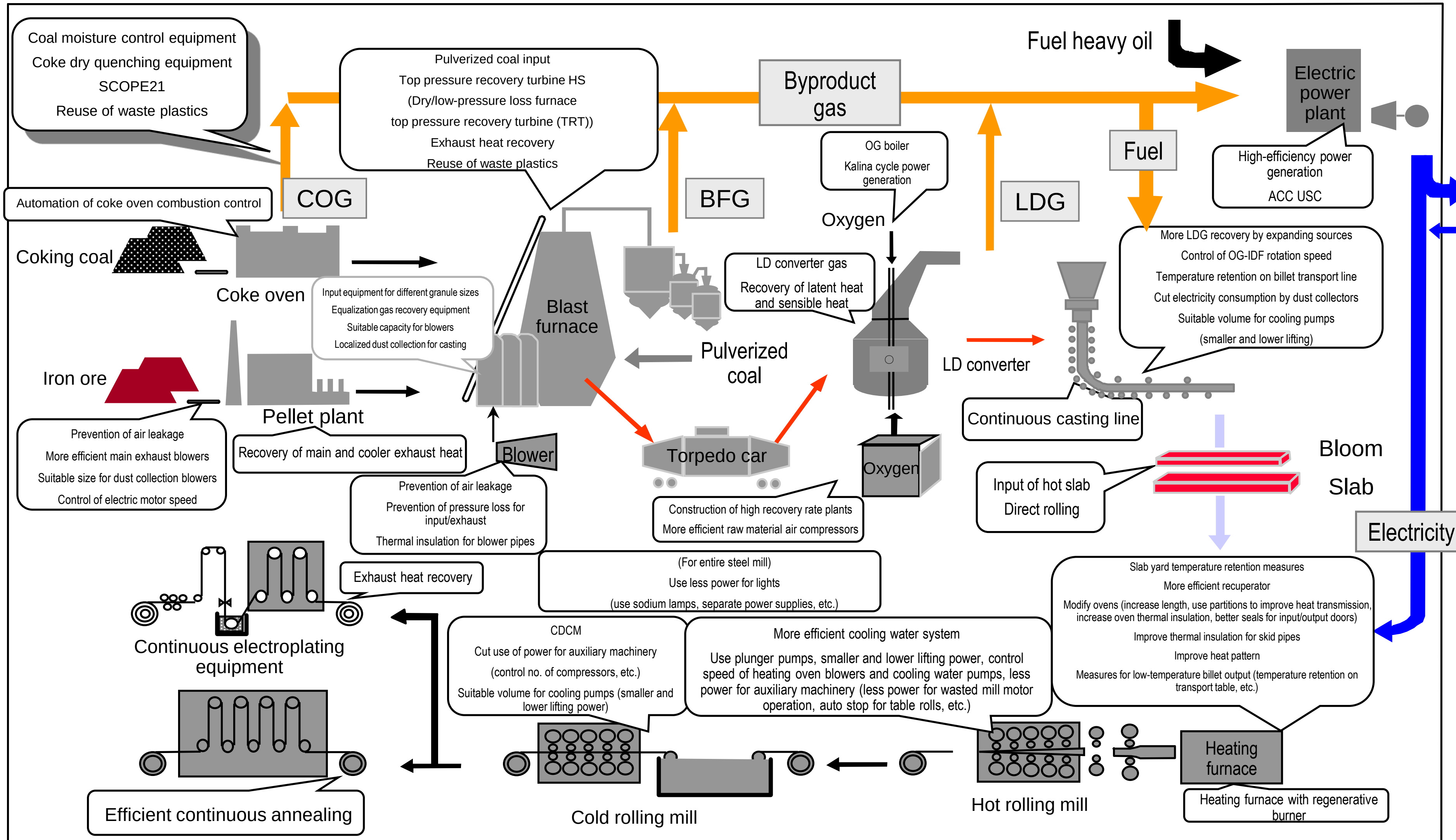
a. Awaiting results of studies concerning a Japanese government review of the container, packaging and plastic recycling system and other related items; may be reviewed (target reduced) if there is no outlook for growth in the waste materials handling capacity of the steel industry by FY2030 in relation to the actual FY2005 capacity.

b. In addition, for the reduction target incorporated in the FY2020 target, awaiting results of a Japanese government study of the recycling system; may be reviewed (target reduced) if there is no outlook for growth in waste materials handling capacity by FY2020 in proportion to the above target.

*3 For the development and use of revolutionary technologies, assumptions are that (a) technologies will be in use in FY2030 and (b) the use of these technologies is economically feasible. In addition, for COURSE50, assumptions are that an international equal footing is established and the necessary social infrastructure is created, including the site selection and establishment of a storage facility for government-led carbon capture and sequestration programs. Targets will be reexamined if these conditions are not fulfilled.

*4 Within the target for the 5 million ton reduction in CO2 emissions in FY2020, the primary focus is on a 3 million ton reduction in CO2 emissions by steelmakers' own initiatives for efficient use of energy and other ways. Concerning the collection of waste plastics and other ways, only an increase in the collected volume compared to FY2005 is counted as the amount of reduction in emissions

Steel Production Processes and Development and Use of Energy Conservation Technologies



(Reference) Change in Product Mix for Downstream Evaluations